## **Supplemental Methods**

#### 1. Worm body backbone detection

We developed two algorithms, BDB<sup>+</sup> and BDB<sup>-</sup>, to detect the backbone of worm body in 2D and 3D respectively, under different scenarios<sup>1</sup>. Usually auto-fluorescence makes the pixel intensities of the worm body region reliably higher than the image background. It may be even more visible when all Z-sections in a 3D image stack are summed up together and projected to 2D. Under this scenario, a clear boundary of a worm body in the image can be identified. We thus used a simpler algorithm BDB<sup>+</sup> to detect the backbone. Otherwise, when the outer boundary of the worm is hard to detect precisely we used a more sophisticated algorithm BDB<sup>-</sup> to detect backbone. For the 15 images we used to build the atlas, we used the BDB<sup>+</sup> algorithm. Supplementary Figure 1 illustrates the BDB<sup>+</sup> algorithm. Supplementary Video 1 upper and middle panels demonstrates a 3D image before and after 3D straightening.

[Supplementary Figure 1 near here]

[Supplementary Video 1 near here]

#### 2. Intensity filling of hollow-shaped nuclei

Some cells have a large nucleolus which is unstained by the reagent DAPI and this gives the nucleus a hollowed-out shape. Such a pattern can easily be broken into pieces when we apply thresholding and watershed algorithm to segment nuclear region

from the image background. Thus we first detected these hollow-shaped patterns and filled them using the pixels surrounding them (Supplementary Fig. 2b).

Let I be the preprocessed image after straightening and filtering. We thresholded the image at multiple intensity levels v ( $v \in [v_{min}, v_{max}]$ , where  $v_{min}$  is the lowest intensity level of a typical nucleus determined by  $\mu + 2\sigma$ , with  $\mu$  and  $\sigma$  being the mean and standard deviation of the intensity of image I). A "hole" in the thresholded image  $T_v(I)$  is any connected component of background pixels for which all of their surrounding foreground pixels are in a single connected component. The set of all pixels in holes,  $o(T_v(I))$  can be found with a morphological "fill" operation in time linear in the number of pixels in I. We then took the union of all the holes found at each level, i.e:

$$H = \bigcup_{V} o(T_{V}(I)) = \{h_{1}, h_{2}, ..., h_{n}\}$$
 (1)

where each hole  $h_i$  ( $i \in [1,n]$ ) is a connected components of H.

By doing so, most observed holes in *H* are made by nucleoli. Unfortunately, a hole may also be the space between tightly clustered nuclei. However, a hole made by a nucleolus is convex, whereas a space between clustered nuclei is not. We thus selected the subset of the holes in *H* whose convexity values, defined as the ratio between the volume of the hole and the volume of its convex hull, are bigger than 0.9 as the real holes that need to be filled. The value 0.9 was chosen empirically so that the number of false positives is very low.

For each hole  $h_i$  thus found, we then dilated it with a unit sphere structural element e, i.e,  $h_i^+ = h_i \oplus e$  to get all the pixels  $h_i^+ - h_i$  surrounding  $h_i$  and then used their values to linearly interpolate intensity values for the pixels in  $h_i$ .

#### 3. Adaptive thresholding

To extract the foreground mask of nuclei or clusters of nuclei, we first thresholded the image using a global background level  $t_0$  determined by Otsu's method<sup>2</sup>. Since the foreground mask  $M_0$  thus obtained contains extra background pixels at places where nuclei are tightly clustered, we then used a local adaptive thresholding to refine the mask. We first uniformly sampled the 3D image, with the sampling step along the radial and axial direction half of the radius of a typical nucleus. For each sampling pixel, we then estimated its background level<sup>2</sup> in a local window centered at that pixel and about twice of the size of a typical nucleus. Finally, using the estimated background levels at the sampling pixels as seeds, we linearly interpolated a 3D background surface of the entire 3D image stack. A pixel in  $M_0$  is set to a foreground pixel if its intensity value is higher than the background level at the same location, obtaining the final foreground mask M (Supplementary Fig. 2c).

# 4. Watershed segmentation

Once the foreground mask of clusters of nuclei has been extracted, we used the 3D watershed algorithm to separate individual nuclei $^{3-5}$  (Supplementary Fig. 2d). We first applied the distance transform to the foreground mask M. The distance transform of a foreground pixel in the mask is the distance between the pixel and the nearest

background pixel. The resulted image is then inverted and one then applies the 3D watershed algorithm<sup>3-5</sup> to this. Briefly, watershed algorithm works in the following way. Imagine an image as a topographic relief being immersed in a lake, with holes pierced in local minima. The catchment basins, which are regions associated with these minima, are filled up with water starting at these local minima and are successively expanded as water level increases. Dams are built at positions when water from different basins meet.

#### 5. Region merging and splitting

After the above processes, most of the regions are correctly segmented. However, there were still a small number of regions over- or under- segmented, which correspond to the cases that a single nucleus was broken into pieces and that multiple nuclei were grouped together respectively. To solve these problems, we developed rule-based and training-based methods to correct segmentation errors. The rule-based method uses the statistical information of the segmented regions to predict regions of wrong segmentation and then uses rules defined on shape, size, and intensity of typical nuclei regions to do region merging/splitting. In the training-based method we trained a classifier to achieve the task (Supplementary Figs. 2e and 2f). More specifically, we first selected 2214 sample regions that fall into the three classes: correctly segmented, oversegmented, and under-segmented nuclei. Then for each sample region, we computed a vector with 25 different image features, including spatial location (3D coordinate of the gravity center of a region), size (volume of the region and the dimensions of the bounding box), intensity (mean, standard deviation, contrast, moment of inertia), and

shape features (surface area, shape factor, convexity, length of major and minor axes, aspect ratio, the maximum, minimum, mean and standard deviation of the radial distance to the gravity center, as well as the ratio between the standard deviation and mean of the radial distance). After that, we selected the 4 (this number is automatically determined) most important features using mRMR feature selection method<sup>6</sup> and used them to train a support vector machine (SVM) classifier<sup>7</sup> (with radial basis function as the kernel). The SVM does not only classify a segmented region to one of the three classes, but also provides the probability of the region falling into each class. We tested the classification accuracy using 10 fold cross validation scheme. Our results showed the trained SVM can achieve 96.85% accuracy in determine if a segmented region is correct, or should be split (under-segmented) or merged (over-segmented).

To merge over-segmented regions, we used a pair-wise hierarchical merging scheme. For each over-segmented region i identified, if it is to be merged with one of its neighboring regions j, the combined region should be predicted as a correctly segmented region. If there are multiple neighboring regions satisfying this condition, we selected the one which when merged with i will generate a region that has the highest probability of being a correctly segmented region, i.e.,  $j = \operatorname{argmax}(P(\operatorname{class}_{ij} = \text{`correct'}))$ . After merging the two regions, we took the combined region as a new one and repeated this process until the probability of the newly formed region being a correctly segmented nucleus region drops or it is predicted as an under-segmented region.

Under-segmented regions are usually generated by inappropriate local foreground masks which may contain extra background pixels thus making watershed algorithm fail

to separate individual nuclei. To split an under-segmented region, we shrunk the foreground mask by thresholding the region at a higher background level detected by applying Otsu's method again to the pixels within the region. This usually generates a foreground mask with a better 'neck' structure so that watershed can successfully separate nuclei. We then applied the watershed algorithm to this new foreground mask and used the merging process described above to correct over-segmentation if necessary. Since the new foreground mask generated by increasing the background level may make the nuclei smaller than their real volumes, we computed the geodesic influence zones<sup>3</sup> of the newly segmented regions in the original region mask  $U_k$  and assigned the remaining pixels in the mask (i.e.,  $p \in U_k \setminus M_k$ ) to the geodesically closest region newly segmented. Supplementary Fig. 2g shows an example of the nuclei segmentation result. Supplementary Video 1 bottom panel shows a typical image and its segmentation result in 3D.

# [Supplementary Figure 2 near here]

#### 6. Annotation tool VANO and manual annotation of nuclei identities

The cross-platform 3D annotation and visualization tool VANO<sup>8</sup> (Supplementary Fig. 3) is developed in C++ and Qt. It allows experts to annotate nuclei by scrutinizing the raw image and the segmentation nuclei that are displayed side by side in 3D tri-viewed and linked together. The annotation results, including cell identities and comments, and the statistical information such as nuclear locations, sizes, gene expression levels automatically computed, are saved in a spread-sheet (Supplementary Fig. 3 lower

panel). In addition to allowing experts to assign cell identities for each of nucleus in 3D, it also provides functions such as splitting, merging, and deleting existing regions and adding new regions, allowing us to evaluate automatic segmentation accuracy, and correct segmentation errors while annotating the nuclei.

# [Supplementary Figure 3 near here]

We annotated nuclei identities based on the anatomy of C. elegans qualitatively described in earlier literatures 11-12, 14-15 and wormatlas 13 (http://www.wormatlas.org). The 81 body wall muscle cells and the anal depressor muscle cell (dep) were labeled by Pmyo-3::GFP so that we could identified them in GFP channel. The 81 body wall muscle cells form four essentially parallel bundles along worm body: dorsal left (21 cells), dorsal right (21 cells), ventral left (19 cells) and ventral right (20 cells). Each bundle is composed of 2 strips: medial stripe and lateral one. Nuclei of 2 stripes are intercalated along each bundle and the most anterior nuclei are medial stripes for every bundle (MusFig32, http://www.wormatlas.org/handbook/mesodermal.htm/musclepartII. htm). The two dorsal bundles are close to each other, so are the two ventral ones. The most posterior two ventral muscle cells are left-right symmetric while dorsal right 23, depressor muscle and dorsal left 23 form a largely straight line along anterior-posterior axis. Using these criteria, we could determine dorsal-ventral and left-right axes of a worm stack, annotate identities of the 82 GFP-expressing nuclei and then use them as landmarks to triangulate other cells. The sphincter muscle cell (sph) is located anterior, ventral and left to dep cell and usually expresses low level Pmyo-3::GFP. The two

intestinal muscle (im) cells are bilaterally symmetric, usually ventral and lateral to intestine 9 right cell (int9R).

Nuclei of 20 intestine cells located along center are tube of trunk (AlimFig1, http://www.wormatlas.org/handbook/alimentary/alimentary2.htm). They are round with large nucleoli. In the anterior-most region a ring of four nuclei surrounds the lumen. Other eight pairs of intestine nuclei are located the lumen along the intestine tube. From int2 to int4, nuclei appear as dorsal and ventral pairs. The int5R (E.arpp) is more ventral than int5L (E.alpp) due to the existence of gonad. But from int6 to int9 nucleus dorsal than the pairs, the left is more right one. Intestine forms a tube along the whole trunk so that annotation of intestine helps divide a worm stack into head, trunk and rectum.

Between body wall muscle ventral left and ventral right bundles, there is a ventral cord of 15 motor-neurons in trunk at L1 stage<sup>12</sup>. The most posterior nucleus (DB7) is significantly anterior to rectal neurons and InD9 and InV9.

The gonad primordium at L1 stage is in the middle of trunk, anterior to intestine and consists of four cells<sup>11</sup>. The middle two larger cells are germ cells; the two somatic cells have smaller nuclei, anterior and posterior to the germ cells, respectively. All four nuclei have relatively large nucleoli. The gonad primordium lies obliquely, with its anterior cells located slightly right and its posterior ones located slightly left.

At each side of trunk, there are four neurons, which have small nuclei<sup>11</sup>. BDU neurons are at the anterior end of trunk, surrounded by large nuclei. ALM neurons are

significantly posterior and dorsal to BDU. CAN neurons are posterior and ventral to ALM, but anterior to gonad. HSN neurons are posterior to gonads.

The four Coelomocytes have small nuclei and are located to anterior part of trunk and adjacent to ventral body wall muscle bundles. Right two coelomocytes are more anterior, very close to each other<sup>11</sup>.

The 12 C lineage-derived Hyp7 nuclei, and 12 V, 12 P, and 2 Q nuclei are bilaterally symmetric 11,12. Hyp7 nuclei are large nuclei with large nucleoli. They are distributed along sub-ventral part of trunk. The anterior ones (hyp7 Caaaaa and hyp7 Cpaaaa) are dorsal-posterior to BDU neurons while the most posterior ones (hyp7 Cpappd and hyp7 Cpappv) have reach rectum. V and P cells are arranged in six similar ventro-lateral pairs located on each side along the body. Relative to its V cell partner, each P cell has smaller nucleolus and is more ventral-lateral. The most anterior V cell (V1) is just posterior to BDU neuron at each side, while the most posterior P cells (P11/12) has reached rectum. Q cells are located posterior to P7/8, anterior to V5 and a little dorsal to V5. M blast cell is located at right side of trunk. It is close to QR and V5R cells, and between intestine and hypodermis layers. M cell has a large, relatively flat nucleus and a large round nucleolus.

Five AB-derived hyp7 nuclei are located laterally and just anterior to trunk<sup>11,12</sup>. They are just anterior to BUD neurons and have large nuclei with large nucleoli. Hyp7 ABarppapa (left) and hyp7 ABarppaapa (right) are more dorsal while hyp7 ABplaapppp (left) and ABpraapppp (right) are more ventral. Hyp7 ABarpaappp is located at right

side and usually posterior to hyp7 ABarpppapa and ABplaapppp. However the relative positions of the three hyp7 nuclei are not fixed. Their annotation can be indecisive in some worms.

There are seven pairs of symmetric lateral cells in the head region<sup>11,12</sup>. Here we only describe one side of a worm. Right anterior to the lateral AB-derived hyp7 is H2 blast cell, which has relative large size and a relative large nucleolus. Right anterior and dorsal to the H2 cell is an amphid sheath cell, which has medium size and nucleolus. Right anterior and dorsal to the H2 cell is an anterior deirid sheath cell, which has small size and invisible nucleolus. The most anterior-lateral nucleus is hyp5, which has large size and large nucleolus. Posterior to hyp5 and between dorsal and ventral muscle bundle is an anterior arcade cell (arc ant DL or arc ant DR)<sup>15</sup>. H0 and H1 blast cells are located between the arcade cell and H2 cell. They have relatively large nucleus and nucleolus and arranged in anterior-posterior order.

There are nine hypodermal nuclei in the most dorsal ridge of the head, which are arranged in anterior-posteior axis<sup>12</sup>. The most anterior and dorsal cell in a worm is hyp4 ABarpapapa, followed by a pair of hyp3 nuclei. More posterior are four hyp6 nuclei, followed by two hyp7 nuclei, which have relatively large size and nucleoli.

There are seven hypodermal nuclei in anterior segment of the most ventral ridge of the head, which are arranged in anterior-posterior axis<sup>12</sup>. The most anterior and ventral cells in a worm are a pair of hyp4 nuclei, followed by an arcade cell (arc ant V)<sup>15</sup>, and then by a pair of hyp6 nuclei. More posterior are a pair of hyp7 nuclei, which have relatively large size and nucleoli.

We also annotated 12 neurons and 3 neurogenic cells in posterior segment of the most ventral ridge of the head<sup>12</sup>. These 15 cells are located between the two ventral muscle bundles. Right anterior to DB3 neuron is retrovesicular ganglion, which is composed of 12 neurons and neurogenic cell W at the anterior end. More anterior is G2 and G1 neurogenic cell.

Excretory cell has a very large nucleus with a very large nucleolus. It is located ventral and anterior to the retrovesicular ganglion<sup>12</sup>.

We annotated 86 pharynx cells. The pharynx forms a separate epithelial tube running inside the cylindrical body (Supplementary Fig. 4)<sup>14</sup>. It is more convenient to annotate pharyngeal cells from its posterior end, which is anterior to intestine.

# [Supplementary Figure 4 near here]

The seven hypodermal nuclei and two T blast cells locate at the posterior end of worm<sup>12</sup>. The seven hypodermal nuclei have relatively large size. Hyp8, hyp9 and the two hyp10 nuclei are arranged at the posterior end of worm. Hyp11 nuclei are dorsal and left to hyp8 and hyp9. The two T cells have large nucleus and nucleoli and are left-right symmetric. They are anterior and dorsal to the hyp8 nucleus. The two hyp7 nuclei are anterior and ventral to the hyp8 nucleus and are located at the ventral middle line of tail.

The 36 rectal cells except muscle cells are located between intestine muscle cells and the T cells<sup>12</sup>. Cells are either left-right symmetric or located in the middle line (DD6, U,

Y/PDA, F, B, DVA and DVC). The most anterior cell is PVT neuron, which is posterior to the intestine muscle cells and in the middle of left-right axis. The most posterior cell is PVR neuron, which has a small nucleus and is dorsal posterior to the T cells. The most ventral posterior cells are PLML and PLMR. They are ventral to the T cells and usually symmetric and right posterior to the T cells. However, sometimes one PLM neuron and even both two can be anterior to the T cells.

#### 7. Registration

Assume we have K images  $T_1 \sim T_k$  that have been straightened, segmented, and annotated. To build the atlas, we mapped each image into a standard space so that nuclear positions are comparable. We thus used affine transform to register the K image stacks against a reference image selected from the K images. The selection of reference image is not random as we will address shortly. Assume we took  $T_i$  as the reference. To register  $T_j$  ( $j \in [1,K] \lor i$ ) against  $T_i$ , we used the centers of the annotated nuclei in  $T_i$  and  $T_j$  as pairs of correspondence points, each pair consists of one nucleus in each image with the same cell name. Assume (x,y,z) and (u,v,w) are the 3D coordinates of one pair of correspondence points in  $T_i$  and  $T_j$  respectively. Assume A is the 3D affine transform matrix, then we have:

$$\mathbf{U} = \mathbf{A} \times \mathbf{X} \tag{2}$$

$$\mathbf{U} = \begin{bmatrix} \mathbf{u} \ \mathbf{v} \ \mathbf{w} \ 1 \end{bmatrix}^{\mathrm{T}} \tag{3}$$

$$\mathbf{X} = \begin{bmatrix} \mathbf{x} \ \mathbf{y} \ \mathbf{z} \ \mathbf{1} \end{bmatrix}^{\mathrm{T}} \tag{4}$$

$$\mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ 0 & 0 & 0 & 1 \end{bmatrix}$$
 (5)

We then derived **A** by **A**= **U**  $X^{-1}$ . Solving this equation needs at least 4 non-coplanar correspondence points. Since we annotated about 357 nuclei in each image, we have 357 pairs of correspondence points. Thus matrix **A** is solved in the sense of least square error. Using the 3D affine transform, we then mapped each  $T_j$  to a new image  $T_j$ , which is of the same size and orientation as the reference image  $T_j$ .

To determine which image should be used as the reference, we repeated this process *K* times. Each time we selected one of the *K* images as the reference and registered the remaining ones to the selected reference. We computed the sum of the squared differences of nuclear locations of all the annotated nuclei in the registered images with respect to the reference. The image that leads to the minimum value was taken as the reference image and all the remaining images were registered to that reference.

### 8. Statistical analysis of nuclear positions

The mean and standard deviation for each of the 357 nuclei along AP dimension have been given in Fig 2. Nuclei whose location standard deviations are more than  $\mu_{std}$  +  $2\sigma_{std}$  along the AP axis (where  $\sigma_{std}$  =0.90 $\mu$ m and  $\mu_{std}$  = 1.87 $\mu$ m) are AMsh(L,R), ccL(1,2), ALM(L,R), HSN(L,R), 9 hyp7 nuclei, Exc gl (L,R), imL, InV(6,7), InD6, LUA(L,R), PLML, ARCAR, Exc, repD, pm1DR, vpi3V, PHshR. The mean and standard deviations along the DV and LR dimensions are further shown in Supplementary Figs.

5a and 5b. Supplementary Table 1 lists values of the mean and standard deviations of the 357 nuclei along AP, DV, and LR dimensions.

[Supplementary Figure 5 near here]

[Supplementary Table 1 near here]

Using the mean values of the nuclear locations along AP, DV, and LR axes, we then represented each nucleus as a sphere at the corresponding locations, with the sizes of the spheres proportional to the average size of that particular nucleus across individual images. We then rendered a 3D nuclei atlas containing 357 nuclei using VANO, as shown in Supplementary Video 2. The four bundles of the body wall muscle cells, ventral-left (VL), ventral-right (VR), dorsal-left (DL), and dorsal-right (DR) bundles, are highlighted in red, green, yellow, and blue respectively.

[Supplementary Video 2 near here]

#### 9. Computing AP/DV/LR graphs

Taking AP graph as an example, we first computed the adjacency matrix  $\mathbf{AP}_k$  for each image  $T_k$ , where  $\mathbf{AP}_k(u,v) = true$  if nucleus u is anterior to nucleus v, or either of u or v is not annotated, and false otherwise<sup>9</sup>. Then the consensus AP adjacency matrix, denoted  $\mathbf{AP}_k$ , can be obtained by applying the simple element-wise AND operation,  $\wedge$ , on the  $\mathbf{AP}_k$ , i.e.,  $\mathbf{AP} = \mathbf{AP}_1 \wedge \mathbf{AP}_2 \wedge ... \wedge \mathbf{AP}_k$ . In this matrix,  $\mathbf{AP}(u,v) = true$  if and only if nucleus u is always anterior to nucleus v in all K templates, and false otherwise (we assumed that

every cell name was used in at least one template). We then represented the adjacency matrix **AP** as a graph, with each nucleus label as a node in the graph, and a directed edge from node u to node v if AP(u,v) = 1. For better visualization, we then applied transitive reduction to remove the edge from u to w, if there is an edge from u to v (meaning u is anterior to v), and an edge from v to w (meaning v is anterior to w). Supplementary Fig. 6 shows the AP graph of all the 357 after transitive reduction. The DV and LR graphs are derived in the same way.

# [Supplementary Figure 6 near here]

## 10. Adding Spatial constraints to automatic nuclei annotation

The bipartite matching scheme<sup>10</sup> does not consider the relative spatial relationships among nuclei within the subject image or within the template images. For example suppose a pair of nuclei (a,b) in the subject S should be mapped to a pair of nuclei (u,v) in the template T, with a to u, b to v, where it is always the case that u is anterior to v in all the templates. The unconstrained bipartite matching is free to match a to v and b to u (as long as the cost is minimized) which is wrong. To solve this problem, we used invariant AP, DV, and LR relationships between nuclei to prune the potentially wrong matching edges<sup>9</sup>. For this purpose, we first derived the AP/DV/LR adjacency matrices, denoted **AP**, **DV**, and **LR** as described earlier. They represent the invariant spatial relationships between the annotated cells in templates used to build the atlas. An element in the AP matrix AP(u,v)=true if nucleus u is always anterior to v in all templates, and false if otherwise. The same meaning applies to **DV** and **LR**.

Given an initial matching that maps nuclei in the subject image S to nuclei in a template  $T_k$ , we constructed AP/DV/LR adjacency matrices for S, denoted **ap**, **Ir**, and **dv**. Take the **ap** matrix as an example, we set an element in **ap**(u,v) = true if a is mapped to u and b is mapped to v, and nucleus a is anterior to nucleus v in the subject image S.

Using these adjacency matrices, we then computed a conflict matrix  $\mathbf{C}$ . An element  $\mathbf{C}(u,v)$  equals *true* if the spatial relationship along AP, or DV, or LR in the templates and in the subject image are contradictory. Mathematically,  $\mathbf{C}$  is computed in the following way:

$$C = C_{ap} \vee C_{lr} \vee C_{dv}$$
 (6)

$$\mathbf{C}_{\mathbf{r}} = [(\mathbf{R}) \wedge (\neg \mathbf{R}^{\mathrm{T}}) \wedge (\neg \mathbf{r}) \wedge (\mathbf{r}^{\mathrm{T}})] \vee [(\neg \mathbf{R}) \wedge (\mathbf{R}^{\mathrm{T}}) \wedge (\mathbf{r}) \wedge (\neg \mathbf{r}^{\mathrm{T}})]$$
(7)

where  $^{V,\Lambda,\neg}$  are the element-wise OR, AND, and NOT operations, respectively, and T is matrix transposition. **R** represents adjacency matrices **AP**, **LR**, **DV**, and **r** represents adjacency matrices **ap**, **Ir**, **dv** respectively. Moreover, when **r** equals say **ap** in Eq. (7) then **R** is **AP**. Observe that  $\mathbf{C}(u,v) = true$  if and only if one or more of the AP, LR, or DV relationships of nuclei a and b in the subject image are contradictory to those of nuclei a and b in the template. Thus at least one of a and b is wrongly recognized.

Using the conflict matrix  $\mathbf{C}$ , we counted, for each nucleus a to be recognized in the subject image S, the number of nuclei in S that have a contradictory AP/LR/DV relationships with nucleus a, i.e.,

$$conflict(a) = |\{b \mid C(u,v) = 1, a \rightarrow u, b \rightarrow v\}|$$
 (8)

We then selected, with high confidence, the nucleus in the subject image S that had the maximum number of conflicted nuclei as the one that had been wrongly labeled by the current matching. We then removed the edge between this nucleus in S and its mapped nucleus in the template  $T_k$  and rerun the bipartite matching. This process is repeated until  $\Sigma_a$ conflict(a) does not decrease for  $t_{max}$  sequential steps ( $t_{max}$ =3 for the results reported, but other values yielded similar results.). Once terminated, one takes as the answer the matching that gives the minimum  $\Sigma_a$ conflict(a).

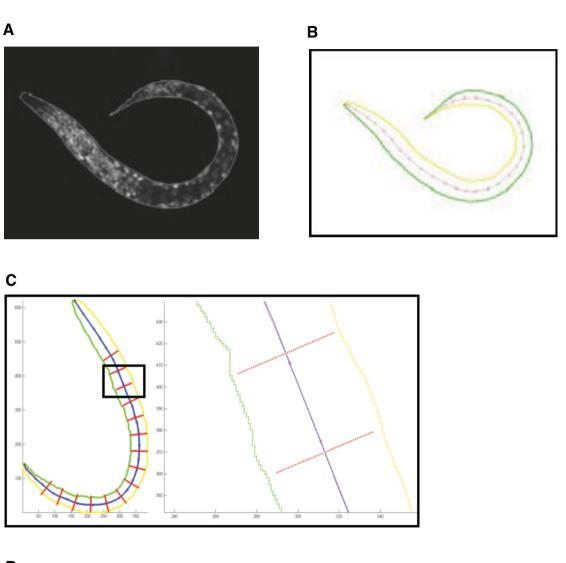
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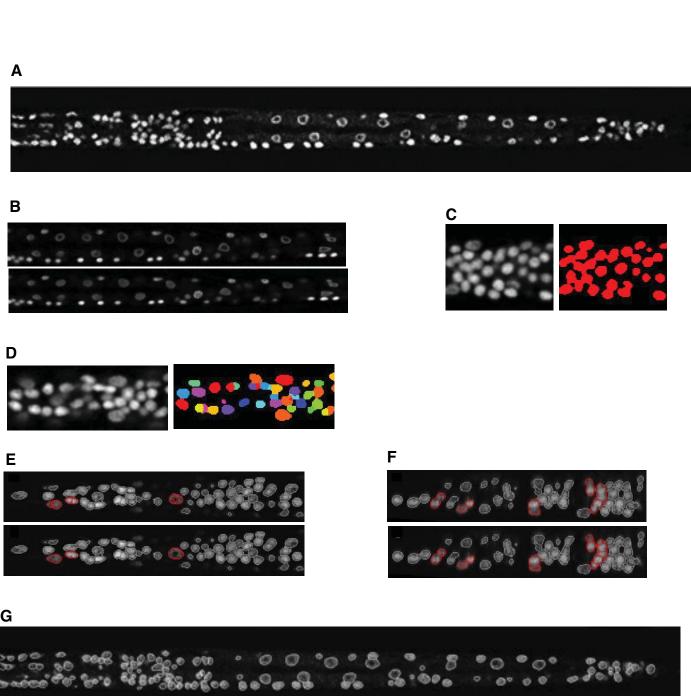
# **Supplementary Figures**

**Figure 1**. Worm body straightening. (**a**) A 3D image is projected to 2D by summing up all slices along Z. The detected boundary of the worm body is highlighted. (**b**) Estimated anterior-posterior (AP) axis (curve in red color) and dorsal/ventral sides (yellow and green curves). (**c**) Straightening the worm body in 3D by generating dense cutting planes orthogonal to the AP axis and then restacking the planes to make them parallel. (**d**) A single 2D slice of the 3D image after straightening.



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**Figure 2**. Illustration of the automated 3D nuclei segmentation steps. (**a**) A 2D slice of a 3D L1 worm image. (**b**) Before (upper panel) and after (lower panel) hole-filling. (**c**) The foreground mask (right) of a small portion of the head (left) obtained by adaptive thresholding. (**d**) An example of watershed segmentation (right). (**e**) Before (upper panel) and after (lower panel) merging over-segmented regions. (**f**) Before (upper panel) and after (lower panel) splitting under-segmented regions. (**g**) The contours of segmented nuclei overlaid on A.



**Figure 3**. A snapshot of the interface of the 3D nuclei annotation and visualization tool VANO and the spread-sheet generated by annotation.

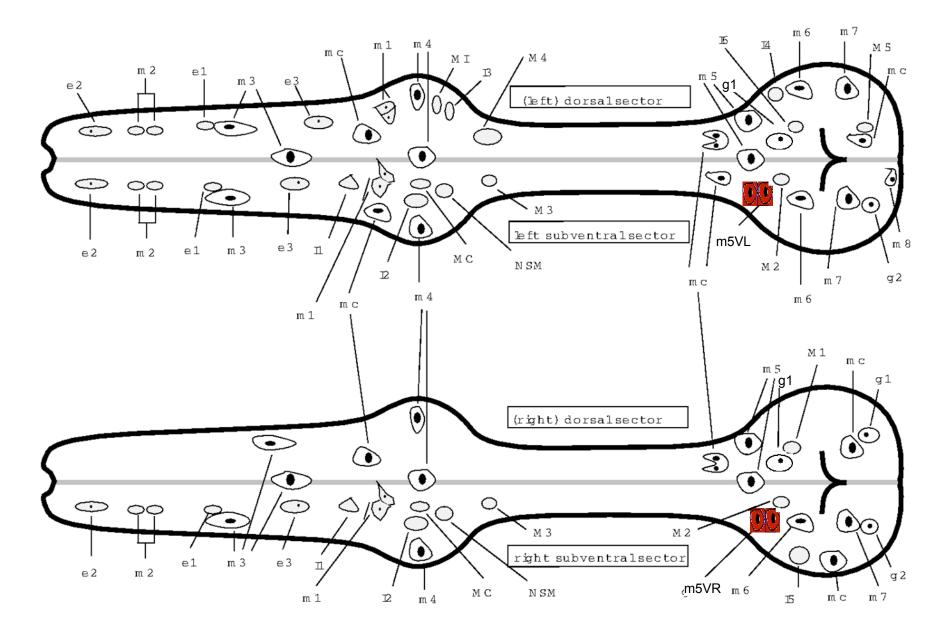
# Supplementary Figure 3

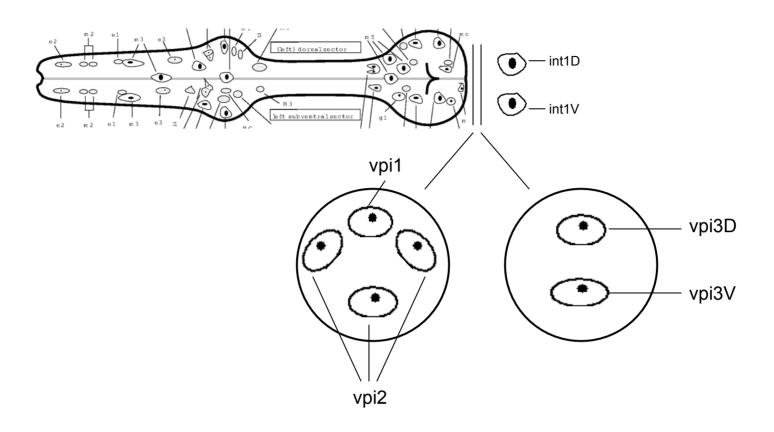


Order	Cell label	Name	Comments	Z (page)	X	Y	Peak intensity	Ave Intensity	Std Dev	Size	Mass
85	85	MCR		65	184	76	189	88.18	37.81	1046	92241
36	86	hyp6 ABarpa		65	184	48	147	78.19	29.35	918	71777
87	87			82	188	56	99	30.28	15.37	666	20166
88	88	bwmVR4		59	189	93	138	75.52	28.92	905	68348
89	89	pm4DL		68	189	58	171	95.01	28.48	1162	110396
90	90	12R		59	189	82	194	124.53	29.98	530	66002
91	91	12L		79	190	74	185	88.38	37.95	1780	157311
92	92	pm4VR		65	190	85	152	81.97	27.58	1067	87462
93	93	pm4R		56	191	74	213	90.54	40.28	1027	92987
94	94			53	191	86	216	100.55	53.06	746	75007
95	95	pm4L		81	192	65	150	70.34	25.36	1043	73366
96	96	bwmDR4		48	193	64	137	76.12	22.93	1059	80607

**Figure 4.** Arrangement of pharyngeal nuclei in newly hatched L1. (**a**) Pairs of pharyngeal m2 nuclei have ambiguous cell lineage identities. For convenience, the anterior nucleus is denoted (I) and the posterior one is denoted (r). This figure is modified from http://elegans.swmed.edu/Worm\_labs/Avery/Pictures/RE\_pharynx.gif. (**b**) Pharyngeal-intestinal valve cells, extrapolated from AlimFig1, http://www.wormatlas.org/handbook/ alimentary/ alimentary2.htm.

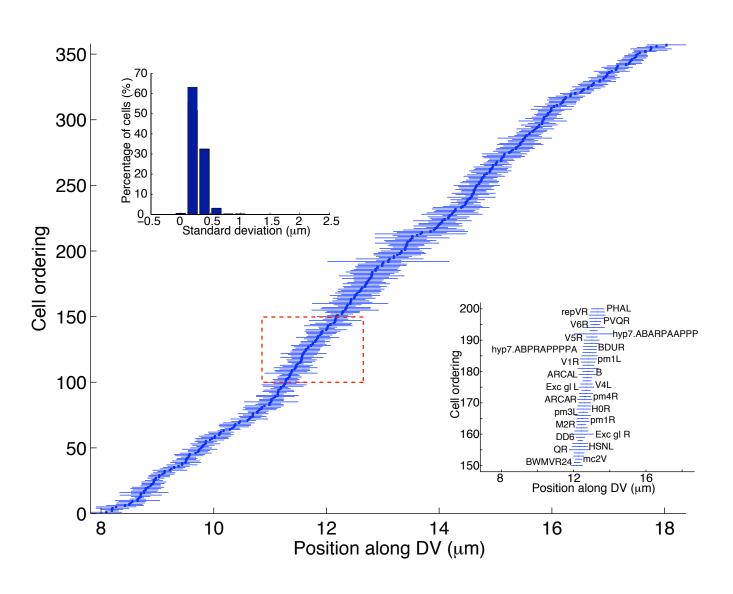
# Nucleiof N2 Pharynxes



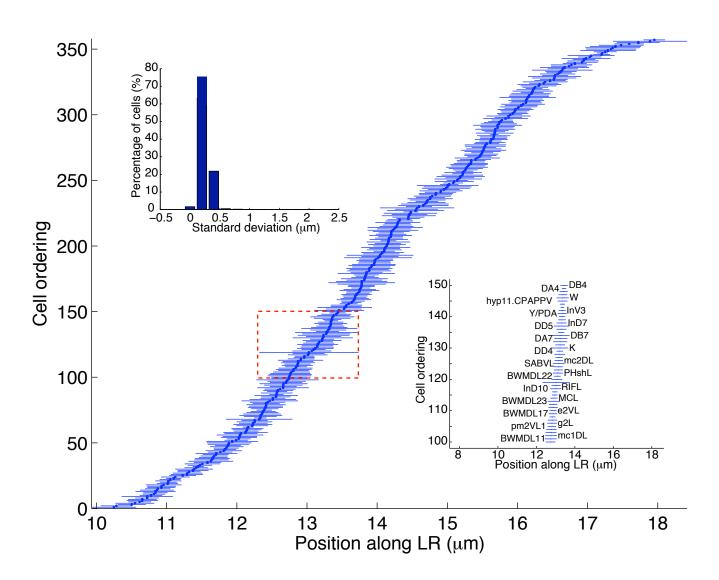


**Figure 5**. The mean and standard deviations of the nuclear locations of 357 cells along DV (**a**) and LR (**b**) axes computed from 15 images of L1 hermaphrodites larvae. The horizontal axis is the position of nuclei along DV (**a**) or LR (**b**) axes (in μm), the dorsal side and right side being positive respectively. The vertical axis is the ordering of the nuclei sorted according to their mean locations along DV (**a**) or LR (**b**). The dots are the mean locations of the corresponding nuclei and the lines are their standard deviations. The bottom-right insets show the names of a subset of nuclei. The up-left insets show the distribution of the standard deviation of nuclei.

A



В



**Figure 6**. AP graph of all the 357 nuclei included in the atlas. The graph is displayed after transitive reduction. Thus if there is a directed path from node a to node b, and from node b to node c, then the transitively inferable edge from a to c is removed.



# **Supplementary Table**

**Table 1** The mean (columns 2 to 4) and standard deviations (columns 5 to 7) of the 357 nuclei along AP, DV, and LR dimensions. The unit is  $\mu m$ . A nuclei name converting table for these 357 nuclei is also attached at the end.

Cell Name	mean of AP	mean of DV	mean of LR	std of AP	std of DV	std of LR
AMshL	79.2892	15.3979	11.0345	4.5699	0.4924	0.4919
AMshR	78.5207	15.4032	17.3936	4.5988	0.4376	0.3595
Exc gl L	84.3402	12.8521	11.1337	2.7562	0.9934	0.321
Exc gl R	85.0748	13.1296	16.9897	2.6249	1.2512	0.4254
H0L	38.503	12.7032	10.8278	1.0009	0.5479	0.24
H0R	38.4407	12.8258	17.6701	1.3584	0.6016	0.2842
H1L	54.0933	12.6733	10.5231	1.7838	0.4837	0.2986
H1R	54.5823	12.4906	17.6524	1.6542	0.6546	0.4452
H2L	80.8515	13.3419	10.4817	2.768	0.6197	0.3405
H2R	80.2052	13.1405	17.7454	2.8752	0.6624	0.4676
P1/2L	105.1235	11.3266	10.8347	1.2636	0.4769	0.2223
P1/2R	105.9381	11.0676	16.9702	1.2944	0.3564	0.2299
P11/12L	187.4195	13.068	11.4788	2.384	0.5553	0.3852
P11/12R	188.4221	12.4778	15.9975	1.4348	0.5406	0.309
P3/4L	119.023	11.6927	10.9839	1.3515	0.3705	0.2531
P3/4R	119.5913	11.2571	16.9111	1.1821	0.419	0.2292
P5/6L	136.2896	11.9026	10.7792	1.6648	0.3933	0.2161
P5/6R	134.0358	11.4247	16.6373	1.6819	0.4719	0.2968
P7/8L	155.0697	11.9358	11.1463	1.1387	0.6276	0.2401
P7/8R	153.0243	11.3378	16.0986	1.6993	0.5759	0.3131
P9/10L	172.016	12.3132	11.5174	1.1476	0.4041	0.3005
P9/10R	169.8823	11.6418	15.9816	2.1884	0.5219	0.3008
QL	161.8539	13.375	11.4226	1.8664	0.684	0.2455
QR	157.9274	12.4792	16.2754	2.3854	0.7056	0.2731
V1L	98.5819	13.3298	10.8481	1.8035	0.5004	0.2601
V1R	100.0654	12.7913	17.1507	1.4883	0.3633	0.3766
V2L	111.7817	12.2995	10.8884	1.3043	0.3965	0.2234
V2R	112.6251	11.8823	17.0743	1.0753	0.404	0.1833
V3L	127.6555	12.5236	10.9628	1.2264	0.4539	0.2289
V3R	127.7134	12.0482	16.775	1.1097	0.457	0.274
V4L	147.9913	12.7666	11.0291	1.0667	0.5388	0.1987
V4R	147.1731	12.3309	16.4861	1.4461	0.5905	0.3541
V5L	168.2358	13.273	11.598	1.3457	0.5871	0.263
V5R	166.5293	12.7655	16.2107	1.0258	0.4394	0.2152

V6L	178.5514	13.6903	11.5485	1.2667	0.6265	0.1774
V6R	177.9455	13.1112	16.165	1.2452	0.4445	0.2293
BWMVR1	30.2051	10.8939	16.6259	1.4332	0.5577	0.3125
BWMDL1	30.2364	14.6142	11.9492	1.7692	0.4957	0.2741
BWMDR1	30.3896	14.7454	16.5772	1.5345	0.4561	0.2205
BWMVL1	30.2349	10.8502	11.7122	1.5538	0.5364	0.3421
BWMVL2	34.2202	9.8617	11.9672	1.7403	0.3739	0.3601
BWMDR2	34.5752	15.5788	16.2755	1.2125	0.4531	0.2063
BWMDL2	34.5038	15.5386	12.3158	1.5035	0.4025	0.3021
BWMVR2	34.1051	9.9245	16.1293	1.324	0.4166	0.3794
BWMDR3	39.8387	16.2179	16.1831	1.9161	0.4153	0.3762
BWMDL3	39.9062	16.1639	12.4308	1.6493	0.316	0.4419
BWMVL3	39.5495	9.3094	12.1898	1.9406	0.2824	0.3044
BWMVR3	39.3914	9.3069	15.8536	1.5065	0.3208	0.3639
BWMVR4	46.1034	9.763	16.3916	1.5658	0.3383	0.3738
BWMDL4	46.0471	15.8677	11.7771	1.566	0.3214	0.4454
BWMVL4	46.6074	9.901	11.4416	1.4292	0.366	0.2426
BWMDR4	46.281	15.8622	16.7947	2.0142	0.3707	0.2203
BWMDR5	52.7785	16.8701	16.0776	1.5574	0.3772	0.3017
BWMVL5	54.0738	9.2148	12.1031	1.4628	0.5038	0.2755
BWMDL5	53.7371	16.9053	12.4625	1.8395	0.3466	0.4845
BWMVR5	53.423	9.0914	15.6014	1.1897	0.3365	0.4105
BWMVR6	56.865	9.7931	16.4565	1.375	0.368	0.4171
BWMDL6	57.1763	16.4106	12.0041	2.2646	0.5035	0.4427
BWMDR6	56.1835	16.4501	16.5026	2.1117	0.4073	0.4556
BWMVL6	58.8442	9.9501	11.3909	2.1109	0.4212	0.3114
BWMVR7	68.9902	8.9239	15.6659	1.4377	0.3705	0.3367
BWMDR7	70.2763	17.6773	15.7149	1.6073	0.368	0.4327
BWMDL7	73.2761	17.6802	12.811	2.8369	0.428	0.5874
BWMVL7	71.9593	8.9924	12.145	3.1203	0.4174	0.2436
BWMVR8	79.4071	9.4042	16.0092	2.8789	0.3104	0.2849
BWMVL8	80.3263	9.6401	11.8696	2.6859	0.3434	0.2669
BWMDL8	80.2072	17.4042	12.282	2.8889	0.3713	0.4585
BWMDR8	77.0335	17.4676	16.4091	2.9269	0.2998	0.4452
BWMVR9	84.1651	9.3094	15.5545	1.6727	0.3667	0.2532
BWMVL9	85.6463	9.2735	12.3986	2.1612	0.4413	0.2563

BWMDR9         82.666         17.8261         15.8058         2.4419         0.2915         0.3942           BWMDR10         87.1728         17.0045         16.4689         2.8788         0.2735         0.2926           BWMVL10         91.9713         9.7545         11.7855         3.2538         0.2845         0.3809           BWMDL10         91.5246         17.2283         12.3698         3.0518         0.3099         0.4865           BWMVR10         90.3134         9.4419         15.7929         2.0458         0.2374         0.2497           BWMDL11         100.91         17.5189         12.8379         1.7242         0.2157         0.4205           BWMVR11         97.509         9.4935         15.3974         1.7206         0.2584         0.241           BWMDR11         104.3065         9.5585         12.4575         1.9948         0.1766         0.1686           BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474	BWMDL9	84.927	17.5751	12.9203	1.976	0.2811	0.4465
BWMVL10         91.9713         9.7545         11.7855         3.2538         0.2845         0.3809           BWMDL10         91.5246         17.2283         12.3698         3.0518         0.3099         0.4865           BWMVR10         90.3134         9.4419         15.7929         2.0458         0.2374         0.2497           BWMDL11         100.91         17.5189         12.8379         1.7242         0.2157         0.4205           BWMVR11         97.509         9.4935         15.3974         1.7206         0.2584         0.241           BWMDR11         104.3065         9.5585         12.4575         1.9948         0.1766         0.1686           BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMDL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDL13         117.2876         9.7714         12.4879         1.2968         <	BWMDR9	82.666	17.8261	15.8058	2.4419	0.2915	0.3942
BWMDL10         91.5246         17.2283         12.3698         3.0518         0.3099         0.4865           BWMVR10         90.3134         9.4419         15.7929         2.0458         0.2374         0.2497           BWMDL11         100.91         17.5189         12.8379         1.7242         0.2157         0.4205           BWMVR11         97.509         9.4935         15.3974         1.7206         0.2584         0.241           BWMDR11         104.3065         9.5585         12.4575         1.9948         0.1766         0.1686           BWMDR11         95.6716         17.5876         15.739         2.0713         0.2845         0.2505           BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMVL13         117.2876         9.7714         12.4879         1.2968         <	BWMDR10	87.1728	17.0045	16.4689	2.8788	0.2735	0.2926
BWMVR10         90.3134         9.4419         15.7929         2.0458         0.2374         0.2497           BWMDL11         100.91         17.5189         12.8379         1.7242         0.2157         0.4205           BWMVR11         97.509         9.4935         15.3974         1.7206         0.2584         0.241           BWMVL11         104.3065         9.5585         12.4575         1.9948         0.1766         0.1686           BWMDR11         95.6716         17.5876         15.739         2.0713         0.2845         0.2505           BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848 <td< td=""><td>BWMVL10</td><td>91.9713</td><td>9.7545</td><td>11.7855</td><td>3.2538</td><td>0.2845</td><td>0.3809</td></td<>	BWMVL10	91.9713	9.7545	11.7855	3.2538	0.2845	0.3809
BWMDL11         100.91         17.5189         12.8379         1.7242         0.2157         0.4205           BWMVR11         97.509         9.4935         15.3974         1.7206         0.2584         0.241           BWMVL11         104.3065         9.5585         12.4575         1.9948         0.1766         0.1686           BWMDR11         95.6716         17.5876         15.739         2.0713         0.2845         0.2505           BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDR13         117.2139         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848         <	BWMDL10	91.5246	17.2283	12.3698	3.0518	0.3099	0.4865
BWMVR11         97.509         9.4935         15.3974         1.7206         0.2584         0.241           BWMVL11         104.3065         9.5585         12.4575         1.9948         0.1766         0.1686           BWMDR11         95.6716         17.5876         15.739         2.0713         0.2845         0.2505           BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL13         117.713         17.2913         12.4998         2.0599         0.3072         0.3218           BWMDR13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         129.935         16.9269         16.0974         2.3703	BWMVR10	90.3134	9.4419	15.7929	2.0458	0.2374	0.2497
BWMVL11         104.3065         9.5585         12.4575         1.9948         0.1766         0.1686           BWMDR11         95.6716         17.5876         15.739         2.0713         0.2845         0.2505           BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL12         109.9199         17.105         12.4998         2.0599         0.3072         0.3218           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDR13         112.1239         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703	BWMDL11	100.91	17.5189	12.8379	1.7242	0.2157	0.4205
BWMDR11         95.6716         17.5876         15.739         2.0713         0.2845         0.2505           BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL12         109.9199         17.105         12.4998         2.0599         0.3072         0.3218           BWMDR13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDR13         112.1239         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848         0.3229         0.3228           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703	BWMVR11	97.509	9.4935	15.3974	1.7206	0.2584	0.241
BWMDR12         105.0835         17.0459         16.1712         1.9495         0.3194         0.2875           BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL12         109.9199         17.105         12.4998         2.0599         0.3072         0.3218           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDR13         112.1239         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVR13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703         0.2084         0.3514           BWMVL14         126.4921         17.1815         12.6207         1.7279         0.2765         0.2768           BWMVR15         130.382         10.2806         15.2148         1.404	BWMVL11	104.3065	9.5585	12.4575	1.9948	0.1766	0.1686
BWMVR12         108.0916         9.7028         15.6752         1.3842         0.3352         0.3166           BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL12         109.9199         17.105         12.4998         2.0599         0.3072         0.3218           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDR13         112.1239         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848         0.3229         0.3228           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703         0.2084         0.3514           BWMVL14         126.4921         17.1815         12.6207         1.7279         0.2765         0.2768           BWMVR15         130.382         10.2806         15.2148         1.404	BWMDR11	95.6716	17.5876	15.739	2.0713	0.2845	0.2505
BWMVL12         111.732         10.0681         11.9005         1.6474         0.265         0.2634           BWMDL12         109.9199         17.105         12.4998         2.0599         0.3072         0.3218           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDR13         112.1239         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848         0.3229         0.3228           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703         0.2084         0.3514           BWMDL14         126.4921         17.1815         12.6207         1.7279         0.2765         0.2768           BWMVR15         130.382         10.2806         15.2148         1.404         0.3016         0.2404           BWMVL16         148.1605         10.8328         12.1905         1.3353	BWMDR12	105.0835	17.0459	16.1712	1.9495	0.3194	0.2875
BWMDL12         109.9199         17.105         12.4998         2.0599         0.3072         0.3218           BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDR13         112.1239         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848         0.3229         0.3228           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703         0.2084         0.3514           BWMDL14         126.4921         17.1815         12.6207         1.7279         0.2765         0.2768           BWMVL14         126.8595         10.3506         12.0316         2.0913         0.2958         0.325           BWMVR15         130.382         10.2806         15.2148         1.404         0.3016         0.2404           BWMVL16         148.1605         10.8328         12.1905         1.3353	BWMVR12	108.0916	9.7028	15.6752	1.3842	0.3352	0.3166
BWMDL13         117.713         17.2913         12.8781         1.5781         0.31         0.3854           BWMDR13         112.1239         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848         0.3229         0.3228           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703         0.2084         0.3514           BWMDL14         126.4921         17.1815         12.6207         1.7279         0.2765         0.2768           BWMVL14         126.8595         10.3506         12.0316         2.0913         0.2958         0.325           BWMVR15         130.382         10.2806         15.2148         1.404         0.3016         0.2404           BWMVL16         148.1605         10.8328         12.1905         1.3353         0.2919         0.258           BWMDR17         126.7395         17.2809         15.5262         2.0331	BWMVL12	111.732	10.0681	11.9005	1.6474	0.265	0.2634
BWMDR13         112.1239         17.3636         15.6619         1.7476         0.3059         0.2123           BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848         0.3229         0.3228           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703         0.2084         0.3514           BWMDL14         126.4921         17.1815         12.6207         1.7279         0.2765         0.2768           BWMVL14         126.8595         10.3506         12.0316         2.0913         0.2958         0.325           BWMVR15         130.382         10.2806         15.2148         1.404         0.3016         0.2404           BWMVL15         134.514         10.4058         12.449         1.258         0.3118         0.3218           BWMVL16         143.9198         10.6261         15.2238         1.3894         0.2671         0.2747           BWMDR17         126.7395         17.2809         15.5262         2.0331	BWMDL12	109.9199	17.105	12.4998	2.0599	0.3072	0.3218
BWMVL13         117.2876         9.7714         12.4879         1.2968         0.233         0.3638           BWMVR13         113.577         9.5847         15.4863         2.3848         0.3229         0.3228           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703         0.2084         0.3514           BWMDL14         126.4921         17.1815         12.6207         1.7279         0.2765         0.2768           BWMVL14         126.8595         10.3506         12.0316         2.0913         0.2958         0.325           BWMVR15         130.382         10.2806         15.2148         1.404         0.3016         0.2404           BWMVL15         134.514         10.4058         12.449         1.258         0.3118         0.3218           BWMVL16         148.1605         10.8328         12.1905         1.3353         0.2919         0.258           BWMDL17         126.7395         17.2809         15.5262         2.0331         0.1871         0.3324           BWMDL17         132.9749         17.2959         12.795         1.4415	BWMDL13	117.713	17.2913	12.8781	1.5781	0.31	0.3854
BWMVR13         113.577         9.5847         15.4863         2.3848         0.3229         0.3228           BWMVR14         123.1617         9.9944         15.6033         1.7864         0.2798         0.2717           BWMDR14         119.935         16.9269         16.0974         2.3703         0.2084         0.3514           BWMDL14         126.4921         17.1815         12.6207         1.7279         0.2765         0.2768           BWMVL14         126.8595         10.3506         12.0316         2.0913         0.2958         0.325           BWMVR15         130.382         10.2806         15.2148         1.404         0.3016         0.2404           BWMVL15         134.514         10.4058         12.449         1.258         0.3118         0.3218           BWMVL16         148.1605         10.8328         12.1905         1.3353         0.2919         0.258           BWMVR16         143.9198         10.6261         15.2238         1.3894         0.2671         0.2747           BWMDL17         132.9749         17.2959         12.795         1.4415         0.2781         0.2806	BWMDR13	112.1239	17.3636	15.6619	1.7476	0.3059	0.2123
BWMVR14123.16179.994415.60331.78640.27980.2717BWMDR14119.93516.926916.09742.37030.20840.3514BWMDL14126.492117.181512.62071.72790.27650.2768BWMVL14126.859510.350612.03162.09130.29580.325BWMVR15130.38210.280615.21481.4040.30160.2404BWMVL15134.51410.405812.4491.2580.31180.3218BWMVL16148.160510.832812.19051.33530.29190.258BWMVR16143.919810.626115.22381.38940.26710.2747BWMDR17126.739517.280915.52622.03310.18710.3324BWMDL17132.974917.295912.7951.44150.27810.2806	BWMVL13	117.2876	9.7714	12.4879	1.2968	0.233	0.3638
BWMDR14       119.935       16.9269       16.0974       2.3703       0.2084       0.3514         BWMDL14       126.4921       17.1815       12.6207       1.7279       0.2765       0.2768         BWMVL14       126.8595       10.3506       12.0316       2.0913       0.2958       0.325         BWMVR15       130.382       10.2806       15.2148       1.404       0.3016       0.2404         BWMVL15       134.514       10.4058       12.449       1.258       0.3118       0.3218         BWMVL16       148.1605       10.8328       12.1905       1.3353       0.2919       0.258         BWMVR16       143.9198       10.6261       15.2238       1.3894       0.2671       0.2747         BWMDR17       126.7395       17.2809       15.5262       2.0331       0.1871       0.3324         BWMDL17       132.9749       17.2959       12.795       1.4415       0.2781       0.2806	BWMVR13	113.577	9.5847	15.4863	2.3848	0.3229	0.3228
BWMDL14       126.4921       17.1815       12.6207       1.7279       0.2765       0.2768         BWMVL14       126.8595       10.3506       12.0316       2.0913       0.2958       0.325         BWMVR15       130.382       10.2806       15.2148       1.404       0.3016       0.2404         BWMVL15       134.514       10.4058       12.449       1.258       0.3118       0.3218         BWMVL16       148.1605       10.8328       12.1905       1.3353       0.2919       0.258         BWMVR16       143.9198       10.6261       15.2238       1.3894       0.2671       0.2747         BWMDR17       126.7395       17.2809       15.5262       2.0331       0.1871       0.3324         BWMDL17       132.9749       17.2959       12.795       1.4415       0.2781       0.2806	BWMVR14	123.1617	9.9944	15.6033	1.7864	0.2798	0.2717
BWMVL14       126.8595       10.3506       12.0316       2.0913       0.2958       0.325         BWMVR15       130.382       10.2806       15.2148       1.404       0.3016       0.2404         BWMVL15       134.514       10.4058       12.449       1.258       0.3118       0.3218         BWMVL16       148.1605       10.8328       12.1905       1.3353       0.2919       0.258         BWMVR16       143.9198       10.6261       15.2238       1.3894       0.2671       0.2747         BWMDR17       126.7395       17.2809       15.5262       2.0331       0.1871       0.3324         BWMDL17       132.9749       17.2959       12.795       1.4415       0.2781       0.2806	BWMDR14	119.935	16.9269	16.0974	2.3703	0.2084	0.3514
BWMVR15       130.382       10.2806       15.2148       1.404       0.3016       0.2404         BWMVL15       134.514       10.4058       12.449       1.258       0.3118       0.3218         BWMVL16       148.1605       10.8328       12.1905       1.3353       0.2919       0.258         BWMVR16       143.9198       10.6261       15.2238       1.3894       0.2671       0.2747         BWMDR17       126.7395       17.2809       15.5262       2.0331       0.1871       0.3324         BWMDL17       132.9749       17.2959       12.795       1.4415       0.2781       0.2806	BWMDL14	126.4921	17.1815	12.6207	1.7279	0.2765	
BWMVL15       134.514       10.4058       12.449       1.258       0.3118       0.3218         BWMVL16       148.1605       10.8328       12.1905       1.3353       0.2919       0.258         BWMVR16       143.9198       10.6261       15.2238       1.3894       0.2671       0.2747         BWMDR17       126.7395       17.2809       15.5262       2.0331       0.1871       0.3324         BWMDL17       132.9749       17.2959       12.795       1.4415       0.2781       0.2806	BWMVL14	126.8595	10.3506	12.0316	2.0913	0.2958	
BWMVL16       148.1605       10.8328       12.1905       1.3353       0.2919       0.258         BWMVR16       143.9198       10.6261       15.2238       1.3894       0.2671       0.2747         BWMDR17       126.7395       17.2809       15.5262       2.0331       0.1871       0.3324         BWMDL17       132.9749       17.2959       12.795       1.4415       0.2781       0.2806	BWMVR15	130.382		15.2148			
BWMVR16       143.9198       10.6261       15.2238       1.3894       0.2671       0.2747         BWMDR17       126.7395       17.2809       15.5262       2.0331       0.1871       0.3324         BWMDL17       132.9749       17.2959       12.795       1.4415       0.2781       0.2806	BWMVL15	134.514	10.4058	12.449	1.258	0.3118	0.3218
BWMDR17       126.7395       17.2809       15.5262       2.0331       0.1871       0.3324         BWMDL17       132.9749       17.2959       12.795       1.4415       0.2781       0.2806	BWMVL16	148.1605	10.8328	12.1905	1.3353	0.2919	0.258
BWMDL17 132.9749 17.2959 12.795 1.4415 0.2781 0.2806	BWMVR16	143.9198	10.6261	15.2238	1.3894	0.2671	0.2747
	BWMDR17	126.7395		15.5262	2.0331	0.1871	0.3324
DWMD110 14E 0000 17 0004 13 4720 1 043 0 3207 0 324	BWMDL17	132.9749				0.2781	
DWMDL10 143.0969 17.0904 12.4739 1.942 0.3297 0.364	BWMDL18	145.0989	17.0904	12.4739	1.942	0.3297	0.364
BWMDR18 138.4478 16.9694 15.6425 1.9267 0.3389 0.3411	BWMDR18	138.4478	16.9694	15.6425	1.9267	0.3389	
BWMDR19 148.9495 16.6608 15.3521 1.6159 0.5455 0.3805	BWMDR19	148.9495	16.6608	15.3521	1.6159	0.5455	0.3805
BWMDL19 155.7054 16.8827 12.7949 2.4452 0.3586 0.2928	BWMDL19	155.7054	16.8827	12.7949	2.4452	0.3586	0.2928
BWMVR19 154.2193 10.714 14.8952 1.2752 0.3359 0.2957	BWMVR19	154.2193	10.714				
BWMDR20 157.8237 16.5761 15.0778 1.2683 0.277 0.4094	BWMDR20						
BWMDL20 167.4923 16.633 12.8257 1.5266 0.4966 0.3757	BWMDL20				1.5266		
BWMVL20 165.5066 10.9617 12.5016 1.3726 0.4694 0.4804	BWMVL20	165.5066	10.9617	12.5016	1.3726	0.4694	0.4804

BWMVR20	164.6989	10.8039	14.9649	2.6799	0.3766	0.3474
BWMDR22	169.4314	16.4528	15.2848	1.5459	0.2627	0.447
BWMVL22	178.0113	11.3199	12.4715	2.1055	0.3596	0.5084
BWMDL22	174.5994	16.6434	13.1308	1.3382	0.3394	0.3475
BWMVR22	178.2483	11.2068	14.8141	1.367	0.2245	0.3999
BWMVL23	200.4987	12.5384	12.844	1.3373	0.34	0.3881
BWMDR23	178.6508	16.3842	15.0785	1.8846	0.3157	0.4179
BWMDL23	183.4375	16.4759	12.9605	3.2878	0.338	0.3807
BWMVR24	200.2523	12.2432	14.356	0.9359	0.3603	0.3322
BWMDR24	199.0303	15.41	14.0412	1.0666	0.3215	0.4261
BWMDL24	202.5051	15.7003	14.0449	0.8314	0.2113	0.4027
DEP	192.9262	16.2198	14.8919	2.2637	0.2931	0.4603
IML	185.134	12.2431	12.2853	2.9502	1.0417	0.4412
IMR	184.0541	11.8148	15.4691	1.6999	0.4898	0.3148
SPH	188.5045	13.271	12.1695	1.0123	0.387	0.228
M	159.3569	14.045	15.5295	1.4946	0.3763	0.3115
CCL1	128.3318	10.5849	12.2128	4.5246	0.3762	0.7837
CCR1	100.2681	10.1209	16.0302	1.9658	0.228	0.3879
CCR2	103.5954	10.0272	15.7808	1.5213	0.2949	0.3922
CCL2	133.5711	10.9736	11.8213	4.4208	0.594	0.4556
Z1	134.3546	11.2027	15.0856	1.5989	0.4311	0.3147
Z2	137.7753	11.9338	14.482	1.8288	0.3784	0.6235
Z4	144.7542	11.3387	12.6331	1.3832	0.3632	0.2557
Z3	141.5134	11.7045	12.9273	1.3549	0.3771	0.1823
INVR1	90.7634	11.2179	15.2915	2.0557	0.2283	0.2914
INDR1	91.3765	15.9921	15.7089	1.6602	0.3959	0.3241
INDL1	91.9531	15.8599	12.8395	1.7662	0.4163	0.3602
INVL1	90.7217	10.8506	12.5826	2.0757	0.3517	0.2333
INV3	99.1568	10.9034	13.4836	1.9613	0.2744	0.3759
IND3	99.3984	16.0312	14.5523	1.6236	0.2075	0.5668
INV4	109.5017	11.1436	13.8663	2.3381	0.2594	0.3337
IND4	108.2125	15.9679	13.96	2.0287	0.3913	0.4159
IND5	118.2131	15.5977	13.9276	2.0686	0.1778	0.2887
INV5	122.3827	11.1678	13.875	2.2013	0.4127	0.3164
INV6	136.05	14.0287	12.7947	3.0357	0.7988	0.618
IND6	129.3993	15.4795	14.6477	1.6876	0.7763	0.4211

IND7	150.9741	15.3234	13.263	1.7453	0.4496	0.4106
INV7	145.1131	13.6064	14.6319	2.4879	0.9307	0.4212
INV8	159.237	11.9156	13.2802	2.188	0.2955	0.2661
IND8	165.2543	15.3198	13.9953	1.5709	0.3825	0.3882
IND9	177.745	15.4165	13.9261	0.9754	0.3475	0.364
INV9	172.9927	12	13.9768	1.5104	0.217	0.5597
INV10	183.9106	12.589	14.3137	0.9709	0.3942	0.4488
IND10	185.5297	15.5155	12.9633	0.9509	0.4176	0.374
BDUR	96.6113	12.8217	16.6419	1.5577	0.4566	0.4472
BDUL	95.3364	13.2058	11.405	2.0141	0.6441	0.2946
ALML	120.005	16.09	11.7588	4.5872	0.4088	0.3251
ALMR	119.0367	15.8699	16.4671	6.1899	0.3473	0.2718
CANR	132.1686	13.4887	16.5022	2.7972	0.4493	0.3202
CANL	136.2313	13.766	11.024	2.5909	0.7123	0.2463
HSNL	146.5365	12.44	11.078	11.3745	0.658	0.2039
HSNR	143.6904	11.609	16.1299	4.151	0.5661	0.376
hyp3.ABPLAAPAAAA	23.7009	16.0014	14.2141	1.6098	0.3308	0.4197
hyp3.ABPRAAPAAAA	26.288	16.0517	14.1686	1.6424	0.3022	0.4475
hyp4.ABARPAPAPA	16.6737	15.0357	14.1938	2.6469	0.4117	0.5034
hyp4.ABPLAAPPAA	16.9571	10.1833	14.178	2.6163	0.4397	0.4452
hyp4.ABPRAAPPAA	20.7696	9.7666	14.2918	2.2078	0.2188	0.3618
hyp5.ABARPAPPAP	25.4284	13.0219	16.9168	1.5889	0.449	0.2902
hyp5.ABPLAAAPAP	24.9271	12.8136	11.6061	1.8288	0.555	0.2399
hyp6.ABPLAAAAPA	31.6947	16.6501	14.3119	2.1872	0.2729	0.4901
hyp6.ABARPAAPAA	36.7031	16.6868	14.3625	2.0062	0.4151	0.4084
hyp6.ABPLAAAAPP	42.569	17.0912	14.2801	2.5551	0.3468	0.2694
hyp6.ABARPAPAPP	45.6965	17.0276	14.1534	1.7242	0.2922	0.4622
hyp6.ABPLAAPPAP	32.1217	8.8456	14.023	2.697	0.4442	0.3619
hyp6.ABPRAAPPAP	39.2078	8.7242	13.9465	3.173	0.2532	0.3272
hyp7.ABARPAAPAP	50.2831	17.6117	14.1865	1.3915	0.4929	0.511
hyp7.ABARPAAPPA	62.3261	18.027	14.2075	2.2661	0.4051	0.4435
hyp7.ABPLAAPPPA	46.5866	8.3512	13.8492	2.9014	0.3614	0.3033
hyp7.ABPRAAPPPA	51.4768	8.2588	13.8666	1.8599	0.2247	0.3437
hyp7.ABARPPPAPA	87.8573	14.0701	10.7148	2.7945	0.7818	0.3059
hyp7.ABARPPAAPA	86.4489	13.3976	17.4711	3.1668	1.114	0.3944
hyp7.ABARPAAPPP	89.601	13.2878	16.462	2.922	1.1017	2.0417

hyp7.ABPLAAPPPP	90.2054	12.7991	10.8195	2.2157	0.7477	0.3065
hyp7.ABPRAAPPPP	91.9882	13.4647	17.2944	2.9339	0.7819	0.3633
hyp7.CAAAAA	101.5401	14.933	10.9567	4.5724	0.3619	0.3491
hyp7.CPAAAA	103.9471	14.6053	16.9152	3.7808	0.4881	1.3954
hyp7.CPAAAP	118.644	14.3452	17.1311	4.0184	0.4359	0.2924
hyp7.CAAAAP	116.8091	14.8404	11.0613	5.0857	0.5061	0.2446
hyp7.CPAAPA	134.8953	14.675	16.8859	2.9867	0.6299	0.414
hyp7.CAAAPA	132.4916	15.2353	11.123	2.1586	0.4152	0.3234
hyp7.CAAAPP	152.7025	14.7835	11.1285	4.3837	0.5974	0.2332
hyp7.CPAAPP	153.1603	14.6572	16.5101	1.3893	0.5596	0.3772
hyp7.CPAPAA	170.5995	15.2925	11.6329	2.3233	0.5658	0.2291
hyp7.CPAPAP	172.3742	14.6608	15.9696	1.9226	0.4182	1.1713
hyp7.CAAPPD	192.8562	15.0669	16.125	3.508	0.5592	0.4424
hyp7.CPAPPD	191.6516	15.6912	11.9014	2.5178	0.4671	0.3746
hyp7.ABPLAPPPPA	205.6218	12.7451	13.7412	1.3993	0.4852	0.4689
hyp7.ABPRAPPPPA	208.2641	12.7282	13.7118	1.3819	0.4878	0.2586
hyp8.ABPLPPPAPAP	212.766	13.2688	13.9047	1.5003	0.6231	0.328
hyp9.ABPRPPPAPAP	216.6096	13.8156	13.7962	1.5739	0.5	0.1826
hyp10.ABPLPPPPPPP	219.2666	14.2346	13.74	1.6552	0.2983	0.2756
hyp10.ABPRPPPPPP	221.9663	14.4202	13.7403	2.2579	0.5295	0.3151
hyp11.CPAPPV	212.5806	14.363	13.3943	1.6649	0.8181	0.3661
EXC	69.3254	10.4155	13.4116	1.3657	0.4605	0.8755
AVG	77.1979	8.572	13.9266	1.9227	0.3566	0.3885
SABD	77.6226	9.1012	14.8454	2.2417	0.4135	0.5226
SABVL	72.9957	8.5568	13.376	1.486	0.4899	0.4392
SABVR	72.9075	8.7625	14.3405	1.9806	0.3265	0.324
RIGL	77.732	8.8487	13.0691	2.1817	0.2685	0.2444
RIGR	82.4366	8.7771	13.5354	2.0963	0.4092	0.4233
RIFL	75.1103	8.9291	13.2219	1.7332	0.404	0.432
RIFR	74.7236	8.9941	14.4948	1.9516	0.4684	0.4133
DD1	80.0885	8.915	13.369	2.3948	0.4508	0.3549
DD2	101.8	9.0119	13.8591	1.7764	0.2339	0.2702
DD3	125.2717	9.3077	13.435	1.6072	0.2489	0.2929
DD4	149.0062	9.8452	13.3149	1.4418	0.3008	0.3646
DD5	169.8986	10.3389	13.42	0.9445	0.2045	0.4841
DD6	189.2695	12.2519	13.5138	1.1397	0.3753	0.4355

DA1	84.5648	8.8786	13.7365	1.8004	0.3339	0.1904
DA2	94.8159	8.9337	13.658	1.8025	0.2529	0.2518
DA3	107.5526	8.8943	13.7482	1.7565	0.2703	0.2667
DA4	122.2212	9.1585	13.5184	1.7939	0.2125	0.301
DA5	139.315	9.5018	13.5157	2.6798	0.2727	0.3253
DA6	159.9205	10.0273	13.4106	1.3188	0.3375	0.4007
DA7	177.3755	10.6037	13.3695	1.2034	0.251	0.4676
DA8	190.3654	11.5681	12.877	1.1362	0.3445	0.4414
DA9	191.1491	11.8151	14.4859	1.0509	0.3952	0.443
DB1	79.9446	8.5452	14.2018	1.7327	0.471	0.5791
DB2	70.9565	8.3695	13.7465	1.7019	0.4004	0.515
DB3	91.2527	8.8748	13.78	1.8673	0.2969	0.2102
DB4	111.9606	8.937	13.5096	1.2902	0.1916	0.2807
DB5	132.9304	9.5754	13.5212	1.3741	0.3072	0.2764
DB6	155.9459	9.9611	13.2815	1.1109	0.3372	0.4391
DB7	173.9199	10.4917	13.4488	1.2419	0.1822	0.4963
PVT	186.5875	11.5147	14.1278	1.138	0.2944	0.408
PVPL	187.4885	11.9692	12.6069	1.5126	0.6319	0.2198
PVPR	188.4491	11.9385	14.8048	1.277	0.4352	0.2933
PVQL	193.6694	13.8411	12.0361	0.8593	0.664	0.423
PVQR	193.899	13.035	15.5114	0.9488	0.4523	0.3065
virL	189.3212	15.0815	13.2298	1.0817	0.3563	0.2563
virR	189.4832	14.4068	14.8201	1.0568	0.4436	0.3001
PHAL	195.6076	13.1918	12.3061	0.781	0.5606	0.2416
PHAR	195.804	12.544	15.05	0.8345	0.6425	0.2189
PHBL	195.6812	14.6467	12.3637	0.8262	0.5882	0.2541
PHBR	196.0306	13.9382	15.4962	0.9961	0.5722	0.3254
LUAL	197.446	14.8396	12.5286	0.7665	0.8086	0.2937
LUAR	197.49	14.1651	15.3239	0.9738	0.7707	0.3628
PVCL	198.7062	13.8709	12.5081	1.0938	0.3409	0.2212
PVCR	198.8902	13.3855	15.0883	1.3996	0.4684	0.2789
ALNL	199.7526	15.4365	12.8839	1.0335	0.2886	0.3649
ALNR	200.0039	14.9724	15.0448	0.8793	0.3691	0.4527
PHshL	201.4279	14.2546	13.0187	1.0931	0.2755	0.3696
PHshR	201.4972	14.089	14.5276	1.2618	0.5834	0.664
PLML	205.2378	13.7289	13.0966	3.0586	0.9307	0.341

PLMR	204.6093	13.5378	14.3418	3.0165	0.6739	0.3975
PVR	207.7403	14.5807	14.1786	2.6687	0.4383	0.4997
DVA	196.3306	15.2158	14.0217	1.1188	0.3391	0.5809
DVC	199.1947	13.9973	13.8202	1.916	0.5892	0.3195
Y_PDA	193.4548	11.0699	13.4414	1.4571	0.2405	0.3773
U	192.0989	12.6073	13.1611	0.9819	0.3321	0.3515
В	197.2684	12.7229	13.6117	1.15	0.5459	0.2062
F	194.6503	14.1519	13.8153	0.8775	0.3031	0.2243
K	193.7243	15.5455	13.2958	0.9098	0.4751	0.7046
K'	193.2935	14.785	15.1901	0.8943	0.3853	0.5105
repD	192.5529	15.8318	13.9741	1.1573	0.6722	0.7353
repVL	190.9468	13.6016	12.1921	0.9427	0.6165	0.2455
repVR	191.0073	13.2314	15.5941	0.8229	0.6244	0.2926
TL	205.8127	14.5202	13.2754	1.0589	0.4268	0.512
TR	205.6555	14.3542	14.5702	1.2362	0.3855	0.4896
pm1DL	41.5893	14.8485	14.0804	1.6107	0.3747	0.5437
pm1DR	41.4313	14.7858	14.8629	1.1925	0.3683	0.6767
pm1L	40.9535	12.6978	12.4973	1.4174	0.5419	0.3239
pm1VL	41.0545	11.1977	12.9004	1.5899	0.468	0.3707
pm1R	40.7154	12.5461	15.8894	1.2446	0.5626	0.2272
pm1VR	40.8782	11.0666	15.1474	1.4515	0.5181	0.3531
pm2D1	26.6143	14.669	14.2634	2.0798	0.2124	0.2823
pm2D2	28.7944	14.773	14.2933	2.0586	0.2529	0.1545
pm2VL1	25.5645	11.4653	12.946	2.2835	0.3338	0.257
pm2VL2	27.7375	11.4481	12.8137	2.1362	0.2831	0.2502
pm2VR1	25.4907	11.6363	15.6559	2.2236	0.3267	0.3237
pm2VR2	27.8554	11.578	15.5977	1.7336	0.3303	0.3035
pm3DL	31.904	14.3688	13.6248	1.2715	0.3692	0.2935
pm3DR	34.4456	14.3914	14.8349	1.3026	0.4481	0.3161
pm3L	36.2824	12.5524	12.6349	1.7027	0.4068	0.3326
pm3VL	31.7293	11.1771	13.1842	1.1011	0.3865	0.3313
pm3R	35.8362	12.4426	15.6671	1.4	0.3771	0.3423
pm3VR	31.5689	11.141	14.9601	1.5973	0.4176	0.4199
pm4DL	44.3583	15.1014	13.2792	1.5422	0.343	0.2974
pm4DR	44.3422	15.0911	15.3902	1.2252	0.2648	0.2609
pm4L	43.9716	13.0817	11.9365	1.5269	0.4505	0.4335

pm4VL	43.7656	10.3525	13.0078	1.5532	0.3627	0.3053
pm4R	43.9142	12.8624	16.2473	1.3783	0.3703	0.1932
pm4VR	43.7973	10.301	14.9811	1.4978	0.2958	0.2963
pm5DL	71.8223	15.3824	13.4769	1.6239	0.5006	0.2608
pm5DR	71.8333	15.5067	14.9348	1.7855	0.5442	0.3186
pm5L	71.8567	13.5737	12.6825	1.9621	0.3541	0.2603
pm5VL	72.5179	11.7271	13.5513	1.9588	0.3322	0.2605
pm5R	71.6505	13.7614	15.7073	1.8204	0.5979	0.2497
pm5VR	72.5345	11.7448	14.8193	2.0237	0.3755	0.2211
pm6D	75.5933	16.2688	14.3106	1.6949	0.3753	0.3007
pm6VL	75.4253	12.2651	12.5282	2.1763	0.2527	0.2214
pm6VR	75.411	12.2616	15.8131	2.0262	0.3551	0.2372
pm7D	78.5098	16.7498	14.2751	1.7168	0.2766	0.3316
pm7VL	78.3769	12.219	12.0822	2.1032	0.3581	0.253
pm7VR	78.498	12.1423	16.1027	2.173	0.3298	0.2393
pm8	81.461	12.1285	14.0164	2.238	0.3977	0.3563
mc1DL	41.6045	14.1653	12.8783	1.5206	0.4001	0.3181
mc1DR	41.5389	14.0166	15.7923	1.318	0.4384	0.3091
mc1V	41.4059	10.4537	14.0028	1.434	0.3871	0.3033
mc2DL	69.8031	14.4008	13.204	1.9795	0.5182	0.2824
mc2DR	69.3575	14.4065	15.1006	1.5399	0.6443	0.2333
mc2V	69.6884	12.2413	14.1826	2.0009	0.3511	0.2339
mc3DL	78.5951	14.6059	11.9222	1.9509	0.4901	0.2903
mc3DR	78.7665	14.6905	16.5954	1.9378	0.2666	0.2393
mc3V	78.4526	10.5774	14.2746	2.208	0.2021	0.3047
vpi1	82.7389	16.2306	14.4741	1.9505	0.4511	0.5456
vpi2DL	82.6554	14.693	12.3631	1.9742	0.5686	0.5232
vpi2DR	82.8286	14.5672	15.9977	1.9675	0.3914	0.2876
vpi2V	82.4441	11.4488	14.0642	2.2647	0.5912	0.5462
vpi3D	83.9921	15.6925	14.1925	2.0144	0.5161	0.5729
vpi3V	83.4732	11.9514	14.108	2.3408	0.4878	0.6262
e1D	32.6375	14.8266	14.3126	1.794	0.3297	0.4972
e1VL	30.7039	11.572	12.631	1.8763	0.3537	0.3433
e1VR	30.8187	11.5889	15.6019	1.8342	0.4162	0.4191
e2D	22.7671	14.6737	14.2737	2.2273	0.2564	0.267
e2VL	21.8997	11.5289	13.0345	2.3651	0.2293	0.2284

e3D         37,8875         14,9011         14,4016         1,6212         0.2132         0.2585           e3VL         34.3         11,4771         12,605         1.3556         0.3201         0.3135           e3VR         34,7601         11,5717         15,6294         1,6809         0.4041         0.3948           I1L         38,5515         11,897         12,8063         1,58         0.3504         0.3307           IIR         38,4653         11,3372         11,93         1,7988         0.3011         0.2283           I2L         43,0853         11,3372         11,93         1,7988         0.3011         0.2283           I2R         43,0739         11,182         16,1489         1,533         0.3982         0.3744           I3         45,8117         15,1384         14,2671         1,2781         0.2283         0.2673           I4         73,3828         16,3462         14,2513         1,5404         0,3773         0.2986           I5         74,2929         10,8755         14,099         2,0503         0,2762         0,308           I6         75,6562         15,8863         12,577         1,6264         0,2945         0,3881      <	e2VR	21.8028	11.6371	15.5801	2.3485	0.4298	0.3094
e3VR         34,7601         11.5717         15.6294         1.6809         0.4041         0.3948           I1L         38.5515         11.897         12.8063         1.58         0.3504         0.3307           I1R         38.4653         11.791         15.4774         1.5706         0.4591         0.2855           I2L         43.0853         11.3372         11.93         1.7988         0.3011         0.2328           I2R         43.0739         11.182         16.1489         1.533         0.3982         0.3744           I3         45.8117         15.1384         14.2671         1.2781         0.2283         0.2673           I4         73.3828         16.3462         14.2513         1.5404         0.3773         0.2986           I5         74.2929         10.8755         14.099         2.0503         0.2762         0.308           I6         75.6562         15.8863         12.577         1.6264         0.2945         0.3881           MCL         42.6922         11.9662         12.9345         1.6374         0.3081         0.2438           MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2945	e3D	37.8875	14.9201	14.4016	1.6212	0.2132	0.2585
I1L         38.5515         11.897         12.8063         1.58         0.3504         0.3307           I1R         38.4653         11.791         15.4774         1.5706         0.4591         0.2855           I2L         43.0853         11.3372         11.93         1.7988         0.3011         0.2328           I2R         43.0739         11.182         16.1489         1.533         0.3982         0.3744           I3         45.8117         15.1384         14.2671         1.2781         0.2283         0.2673           I4         73.3828         16.3462         14.2513         1.5404         0.3773         0.2986           I5         74.2929         10.8755         14.099         2.0503         0.2762         0.308           I6         75.6562         15.8863         12.577         1.6264         0.2945         0.3581           MCR         42.6822         11.9662         12.9345         1.6374         0.3081         0.2438           MCR         42.6822         11.8131         15.2757         1.6264         0.2945         0.3581           MI         44.0883         15.3863         12.577         1.6267         0.3217         0.216      <	e3VL	34.3	11.4771	12.605	1.3556	0.3201	0.3135
IIR         38.4653         11.791         15.4774         1.5706         0.4591         0.2855           I2L         43.0853         11.3372         11.93         1.7988         0.3011         0.2328           I2R         43.0739         11.182         16.1489         1.533         0.3982         0.3744           I3         45.8117         15.1384         14.2671         1.2781         0.2283         0.2673           I4         73.3828         16.3462         14.2513         1.5404         0.3773         0.2986           I5         74.2929         10.8755         14.099         2.0503         0.2762         0.308           I6         75.6562         15.8863         12.577         1.6264         0.2945         0.3581           MCL         42.9562         11.9662         12.9345         1.6374         0.3081         0.2438           MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2949           NSML         44.0883         15.3836         14.3402         1.3018         0.2189         0.299           NSML         45.4828         11.4047         15.725         1.5274         0.2852         0.2762	e3VR	34.7601	11.5717	15.6294	1.6809	0.4041	0.3948
I2L         43.0853         11.3372         11.93         1.7988         0.3011         0.2328           I2R         43.0739         11.182         16.1489         1.533         0.3982         0.3744           I3         45.8117         15.1384         14.2671         1.2781         0.2283         0.2673           I4         73.3828         16.3462         14.2513         1.5404         0.3773         0.2986           I5         74.2929         10.8755         14.099         2.0503         0.2762         0.308           I6         75.6562         15.8863         12.577         1.6264         0.2945         0.3581           MCL         42.9562         11.9662         12.9345         1.6374         0.3081         0.2438           MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2945           MI         44.0883         15.3836         14.3402         1.3018         0.2189         0.299           NSML         45.4828         11.4604         12.3031         1.7052         0.3217         0.2116           NSMR         45.5503         11.4047         15.725         1.5274         0.2852         0.2762	I1L	38.5515	11.897	12.8063	1.58	0.3504	0.3307
I2R         43.0739         11.182         16.1489         1.533         0.3982         0.3744           I3         45.8117         15.1384         14.2671         1.2781         0.2283         0.2673           I4         73.3828         16.3462         14.2513         1.5404         0.3773         0.2986           I5         74.2929         10.8755         14.099         2.0503         0.2762         0.308           I6         75.6562         15.8863         12.577         1.6264         0.2945         0.3581           MCL         42.9562         11.9662         12.9345         1.6374         0.3081         0.2438           MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2945           MI         44.0883         15.3836         14.3402         1.3018         0.2189         0.299           NSML         45.4828         11.4604         12.3031         1.7052         0.3217         0.2116           NSMR         45.5503         11.4047         15.725         1.5274         0.2852         0.2762           M1         75.6296         15.7365         15.9563         1.4781         0.5883         0.2723	I1R	38.4653	11.791	15.4774	1.5706	0.4591	0.2855
I3       45.8117       15.1384       14.2671       1.2781       0.2283       0.2673         I4       73.3828       16.3462       14.2513       1.5404       0.3773       0.2986         I5       74.2929       10.8755       14.099       2.0503       0.2762       0.308         I6       75.6562       15.8863       12.577       1.6264       0.2945       0.3581         MCL       42.9562       11.9662       12.9345       1.6374       0.3081       0.2438         MCR       42.6822       11.8131       15.2755       1.6127       0.325       0.2945         MI       44.0883       15.3836       14.3402       1.3018       0.2189       0.299         NSML       45.4828       11.4047       15.725       1.5274       0.2852       0.2762         M1       75.6296       15.7365       15.9563       1.4781       0.5883       0.2723         M2L       73.2154       12.4379       12.5246       1.8924       0.3022       0.2022         M2R       73.1784       12.6327       16.0257       1.8962       0.4178       0.361         M3L       49.0567       11.8658       12.8971       1.8276       0.2031	I2L	43.0853	11.3372	11.93	1.7988	0.3011	0.2328
I4         73.3828         16.3462         14.2513         1.5404         0.3773         0.2986           I5         74.2929         10.8755         14.099         2.0503         0.2762         0.3088           I6         75.6562         15.8863         12.577         1.6264         0.2945         0.3581           MCL         42.9562         11.9662         12.9345         1.6374         0.3081         0.2438           MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2945           MI         44.0883         15.3836         14.3402         1.3018         0.2189         0.299           NSML         45.4828         11.4604         12.3031         1.7052         0.3217         0.2116           NSMR         45.5503         11.4047         15.725         1.5274         0.2852         0.2762           M1         75.6296         15.7365         15.9563         1.4781         0.5883         0.2723           M2L         73.1784         12.6327         16.0257         1.8962         0.4178         0.361           M3L         49.0567         11.8658         12.8971         1.8276         0.2031         0.2432 </td <td>I2R</td> <td>43.0739</td> <td>11.182</td> <td>16.1489</td> <td>1.533</td> <td>0.3982</td> <td>0.3744</td>	I2R	43.0739	11.182	16.1489	1.533	0.3982	0.3744
I5         74.2929         10.8755         14.099         2.0503         0.2762         0.308           I6         75.6562         15.8863         12.577         1.6264         0.2945         0.3581           MCL         42.9562         11.9662         12.9345         1.6374         0.3081         0.2488           MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2945           MI         44.0883         15.3836         14.3402         1.3018         0.2189         0.299           NSML         45.4828         11.4604         12.3031         1.7052         0.3217         0.2116           NSMR         45.5503         11.4047         15.725         1.5274         0.2852         0.2762           M1         75.6296         15.7365         15.9563         1.4781         0.5883         0.2723           M2L         73.2154         12.4379         12.5246         1.8924         0.3022         0.2022           M2R         73.1784         12.6327         16.0257         1.8962         0.4178         0.361           M3L         49.0567         11.8658         12.8971         1.8276         0.2031         0.2432 </td <td>13</td> <td>45.8117</td> <td>15.1384</td> <td>14.2671</td> <td>1.2781</td> <td>0.2283</td> <td>0.2673</td>	13	45.8117	15.1384	14.2671	1.2781	0.2283	0.2673
I6         75.6562         15.8863         12.577         1.6264         0.2945         0.3581           MCL         42.9562         11.9662         12.9345         1.6374         0.3081         0.2438           MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2945           MI         44.0883         15.3836         14.3402         1.3018         0.2189         0.299           NSML         45.4828         11.4604         12.3031         1.7052         0.3217         0.2116           NSMR         45.5503         11.4047         15.725         1.5274         0.2852         0.2762           M1         75.6296         15.7365         15.9563         1.4781         0.5883         0.2723           M2L         73.2154         12.4379         12.5246         1.8924         0.3022         0.2022           M2R         73.1784         12.6327         16.0257         1.8962         0.4178         0.361           M3L         49.0567         11.8658         12.8971         1.8276         0.2031         0.2432           M3R         49.1127         11.8307         15.2438         1.5887         0.3125         0.1552	I4	73.3828	16.3462	14.2513	1.5404	0.3773	0.2986
MCL         42.9562         11.9662         12.9345         1.6374         0.3081         0.2438           MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2945           MI         44.0883         15.3836         14.3402         1.3018         0.2189         0.299           NSML         45.4828         11.4604         12.3031         1.7052         0.3217         0.2116           NSMR         45.5503         11.4047         15.725         1.5274         0.2852         0.2762           M1         75.6296         15.7365         15.9563         1.4781         0.5883         0.2723           M2L         73.2154         12.4379         12.5246         1.8924         0.3022         0.2022           M2R         73.1784         12.6327         16.0257         1.8962         0.4178         0.361           M3L         49.0567         11.8658         12.8971         1.8276         0.2031         0.2432           M4         49.203         14.2718         14.1635         1.5231         0.232         0.1552           M5         79.1804         15.8854         12.6419         1.7568         0.4173         0.3306     <	15	74.2929	10.8755	14.099	2.0503	0.2762	
MCR         42.6822         11.8131         15.2755         1.6127         0.325         0.2945           MI         44.0883         15.3836         14.3402         1.3018         0.2189         0.299           NSML         45.4828         11.4604         12.3031         1.7052         0.3217         0.2116           NSMR         45.5503         11.4047         15.725         1.5274         0.2852         0.2762           M1         75.6296         15.7365         15.9563         1.4781         0.5883         0.2723           M2L         73.2154         12.4379         12.5246         1.8924         0.3022         0.2022           M2R         73.1784         12.6327         16.0257         1.8962         0.4178         0.361           M3L         49.0567         11.8658         12.8971         1.8276         0.2031         0.2432           M3R         49.1127         11.8307         15.2438         1.5887         0.3125         0.1552           M4         49.203         14.2718         14.1635         1.5231         0.232         0.1578           M5         79.1804         15.8854         12.6419         1.7568         0.4173         0.3306     <	16	75.6562	15.8863		1.6264		
MI       44.0883       15.3836       14.3402       1.3018       0.2189       0.299         NSML       45.4828       11.4604       12.3031       1.7052       0.3217       0.2116         NSMR       45.4828       11.4604       12.3031       1.7052       0.3217       0.2116         NSMR       45.5503       11.4047       15.725       1.5274       0.2852       0.2762         M1       75.6296       15.7365       15.9563       1.4781       0.5883       0.2723         M2L       73.2154       12.4379       12.5246       1.8924       0.3022       0.2022         M2R       73.1784       12.6327       16.0257       1.8962       0.4178       0.361         M3L       49.0567       11.8658       12.8971       1.8276       0.2031       0.2432         M3R       49.1127       11.8307       15.2438       1.5887       0.3125       0.1552         M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639<	MCL	42.9562	11.9662	12.9345	1.6374	0.3081	0.2438
NSML       45.4828       11.4604       12.3031       1.7052       0.3217       0.2116         NSMR       45.5503       11.4047       15.725       1.5274       0.2852       0.2762         M1       75.6296       15.7365       15.9563       1.4781       0.5883       0.2723         M2L       73.2154       12.4379       12.5246       1.8924       0.3022       0.2022         M2R       73.1784       12.6327       16.0257       1.8962       0.4178       0.361         M3L       49.0567       11.8658       12.8971       1.8276       0.2031       0.2432         M3R       49.1127       11.8307       15.2438       1.5887       0.3125       0.1552         M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.313	MCR	42.6822	11.8131	15.2755	1.6127	0.325	
NSMR       45.5503       11.4047       15.725       1.5274       0.2852       0.2762         M1       75.6296       15.7365       15.9563       1.4781       0.5883       0.2723         M2L       73.2154       12.4379       12.5246       1.8924       0.3022       0.2022         M2R       73.1784       12.6327       16.0257       1.8962       0.4178       0.361         M3L       49.0567       11.8658       12.8971       1.8276       0.2031       0.2432         M3R       49.1127       11.8307       15.2438       1.5887       0.3125       0.1552         M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278		44.0883	15.3836	14.3402			
M1       75.6296       15.7365       15.9563       1.4781       0.5883       0.2723         M2L       73.2154       12.4379       12.5246       1.8924       0.3022       0.2022         M2R       73.1784       12.6327       16.0257       1.8962       0.4178       0.361         M3L       49.0567       11.8658       12.8971       1.8276       0.2031       0.2432         M3R       49.1127       11.8307       15.2438       1.5887       0.3125       0.1552         M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.3333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886							
M2L       73.2154       12.4379       12.5246       1.8924       0.3022       0.2022         M2R       73.1784       12.6327       16.0257       1.8962       0.4178       0.361         M3L       49.0567       11.8658       12.8971       1.8276       0.2031       0.2432         M3R       49.1127       11.8307       15.2438       1.5887       0.3125       0.1552         M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426 <td>NSMR</td> <td>45.5503</td> <td>11.4047</td> <td>15.725</td> <td>1.5274</td> <td>0.2852</td> <td>0.2762</td>	NSMR	45.5503	11.4047	15.725	1.5274	0.2852	0.2762
M2R       73.1784       12.6327       16.0257       1.8962       0.4178       0.361         M3L       49.0567       11.8658       12.8971       1.8276       0.2031       0.2432         M3R       49.1127       11.8307       15.2438       1.5887       0.3125       0.1552         M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         W       68.2584       8.5828       13.4221       1.843       0.3661	M1	75.6296	15.7365	15.9563	1.4781		
M3L       49.0567       11.8658       12.8971       1.8276       0.2031       0.2432         M3R       49.1127       11.8307       15.2438       1.5887       0.3125       0.1552         M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661							
M3R       49.1127       11.8307       15.2438       1.5887       0.3125       0.1552         M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661       0.4197         ARCAV       24.4012       9.5986       14.1883       2.0176       0.2991							
M4       49.203       14.2718       14.1635       1.5231       0.232       0.1578         M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661       0.4197         ARCAU       24.4012       9.5986       14.1883       2.0176       0.2991       0.4617         ARCAL       31.3776       12.9039       11.3492       1.9568       0.6287							
M5       79.1804       15.8854       12.6419       1.7568       0.4173       0.3306         g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661       0.4197         ARCAV       24.4012       9.5986       14.1883       2.0176       0.2991       0.4617         ARCAL       31.3776       12.9039       11.3492       1.9568       0.6287       0.3315							
g1AL       74.0577       14.7402       12.3568       1.7322       0.5017       0.3771         g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661       0.4197         ARCAV       24.4012       9.5986       14.1883       2.0176       0.2991       0.4617         ARCAL       31.3776       12.9039       11.3492       1.9568       0.6287       0.3315							
g1AR       73.9558       14.9566       16.1186       1.6977       0.4639       0.3496         g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661       0.4197         ARCAV       24.4012       9.5986       14.1883       2.0176       0.2991       0.4617         ARCAL       31.3776       12.9039       11.3492       1.9568       0.6287       0.3315							
g1P       80.6074       15.6935       15.5454       1.9336       0.3137       0.3272         g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661       0.4197         ARCAV       24.4012       9.5986       14.1883       2.0176       0.2991       0.4617         ARCAL       31.3776       12.9039       11.3492       1.9568       0.6287       0.3315	_						
g2L       80.3949       11.4191       12.9506       2.3046       0.3278       0.333         g2R       80.5197       11.4916       15.1513       2.2119       0.2886       0.3113         G1       61.4851       8.405       13.7388       1.0063       0.2426       0.2491         G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661       0.4197         ARCAV       24.4012       9.5986       14.1883       2.0176       0.2991       0.4617         ARCAL       31.3776       12.9039       11.3492       1.9568       0.6287       0.3315	_						
g2R     80.5197     11.4916     15.1513     2.2119     0.2886     0.3113       G1     61.4851     8.405     13.7388     1.0063     0.2426     0.2491       G2     64.7539     9.035     13.8511     1.0624     0.424     0.2799       W     68.2584     8.5828     13.4221     1.843     0.3661     0.4197       ARCAV     24.4012     9.5986     14.1883     2.0176     0.2991     0.4617       ARCAL     31.3776     12.9039     11.3492     1.9568     0.6287     0.3315	_						
G1 61.4851 8.405 13.7388 1.0063 0.2426 0.2491 G2 64.7539 9.035 13.8511 1.0624 0.424 0.2799 W 68.2584 8.5828 13.4221 1.843 0.3661 0.4197 ARCAV 24.4012 9.5986 14.1883 2.0176 0.2991 0.4617 ARCAL 31.3776 12.9039 11.3492 1.9568 0.6287 0.3315	_						
G2       64.7539       9.035       13.8511       1.0624       0.424       0.2799         W       68.2584       8.5828       13.4221       1.843       0.3661       0.4197         ARCAV       24.4012       9.5986       14.1883       2.0176       0.2991       0.4617         ARCAL       31.3776       12.9039       11.3492       1.9568       0.6287       0.3315							
W     68.2584     8.5828     13.4221     1.843     0.3661     0.4197       ARCAV     24.4012     9.5986     14.1883     2.0176     0.2991     0.4617       ARCAL     31.3776     12.9039     11.3492     1.9568     0.6287     0.3315							
ARCAV 24.4012 9.5986 14.1883 2.0176 0.2991 0.4617 ARCAL 31.3776 12.9039 11.3492 1.9568 0.6287 0.3315							
ARCAL 31.3776 12.9039 11.3492 1.9568 0.6287 0.3315							
ARCAR 32.1269 12.8881 17.1083 1.3986 0.7831 0.239							
	ARCAR	32.1269	12.8881	17.1083	1.3986	0.7831	0.239

```
# Note:

# In the following we display three columns, the first is the most commonly used

# cell/nuclei names in literature, the second column is the lineage name, and the

# column is the cell names used in this paper. In many cases, the cell names in the

# third column are easier to understand for a non-worm-biologist; however, we provide

# all three so that one can easily convert one to another. These three names for any

# cell are also incorporated in the .apo digital atlas file, which is another Supplementary

# file for this paper. The digital atlas file is a common CSV file (comma separated value)

# and can be opened using V3D (http://penglab.janelia.org) or other text/spreadsheet editors

# (e.g. Excel).

# Also note that in the following, if in a row there is no respective name in the third column,

# that means the cell name used in this paper is the same to the conventional name.

#
```

conventional cell name INT1DL INT1VL INT1DR INT1VR	cell lineage name EALAAD EALAAV EARAAD EARAAV
INT2V	EALPA
INT2D	EARPA
INT3V	EALAP
INT3D	EARAP
INT4V	EPLAA
INT4D	EPRAA
INT5L	EALPP
INT5R	EARPP
INT6L	EPLAP
INT6R	EPRAP
INT7L	EPLPA
INT7R	EPRPA
INT8L	EPLPPA
INT8R	EPRPPA
INT9L	EPLPPP
INT9R	EPRPPP

cell name used in this paper INDL1 INVL1 INDR1 INVR1 INV3 IND3 INV4 IND4 INV5 IND5 INV6 IND6 IND7 INV7 IND8 INV8 IND9 INV9 IND10 INV10

MU_BODVL2	MSAPPAPP	BWMVL1
MU_BODVR2	MSPPPAPP	BWMVR1
MU_BODDL2	MSAPAPPA	BWMDL1
MU_BODDR2	MSPPAPPA	BWMDR1
MU_BODVL1	MSAPAPAP	BWMVL2
MU_BODVR1	MSPPAPAP	BWMVR2
MU_BODDL1	MSAPAAAP	BWMDL2
MU_BODDR1	MSPPAAAP	BWMDR2
MU_BODVL4	DAAPA	BWMVL3
MU_BODVR4	DPAPA	BWMVR3
MU_BODDL4	MSAPPPPA	BWMDL3
MU_BODDR4	MSPPPPA	BWMDR3
MU_BODVL3	MSAPPPAA	BWMVL4
MU_BODVR3	MSPPPPAA	BWMVR4
MU_BODDL3	MSAPAPPP	BWMDL4
MU_BODDR3	MSPPAPPP	BWMDR4
MU_BODVL6	DAAPP	BWMVL5
MU_BODVR6	DPAPP	BWMVR5
MU_BODDL6	MSAPPPP	BWMDL5
MU_BODDR6	MSPPPPP	BWMDR5
MU_BODVL5	DAAAA	BWMVL6
MU_BODVR5	DPAAA	BWMVR6
MU_BODDL5	MSAPPPAP	BWMDL6
MU_BODDR5	MSPPPPAP	BWMDR6
MU_BODVL8	MSAAPPPAA	BWMVL7
MU_BODVR8	MSPAPPPAA	BWMVR7
MU_BODDL8	DAPPAA	BWMDL7
MU_BODDR8	DPPPAA	BWMDR7
MU_BODVL7	DAPAA	BWMVL8
MU_BODVR7	DPPAA	BWMVR8
MU_BODDL7	DAAAP	BWMDL8
MU_BODDR7	DPAAP	BWMDR8
MU_BODVL10	MSAAPPPAP	BWMVL9
MU_BODVR10	MSPAPPPAP	BWMVR9
MU_BODDL10	DAPPAP	BWMDL9
MU_BODDR10	DPPPAP	BWMDR9

MU_BODVL9	CAPAAAA	BWMVL10
MU_BODVR9	CPPAAAA	BWMVR10
MU_BODDL9	DAPAP	BWMDL10
MU_BODDR9	DPPAP	BWMDR10
MU_BODVL12	MSAAPPPPA	BWMVL11
MU_BODVR12	MSPAPPPPA	BWMVR11
MU_BODDL12	DAPPPA	BWMDL11
MU_BODDR12	DPPPPA	BWMDR11
MU_BODVL11	CAPAAAP	BWMVL12
MU_BODVR11	CPPAAAP	BWMVR12
MU_BODDL11	CAPPAAA	BWMDL12
MU_BODDR11	CPPPAAA	BWMDR12
MU_BODVL14	MSAAPPPPP	BWMVL13
MU_BODVR14	MSPAPPPPP	BWMVR13
MU_BODDL14	DAPPPP	BWMDL13
MU_BODDR14	DPPPPP	BWMDR13
MU_BODVL13	CAPAAPA	BWMVL14
MU_BODVR13	CPPAAPA	BWMVR14
MU_BODDL13	CAPAPAA	BWMDL14
MU_BODDR13	CPPAPAA	BWMDR14
MU_BODVL16	MSPAPPAA	BWMVL15
MU_BODVR16	MSPAPPAP	BWMVR15
MU_BODVL15	CAPAAPP	BWMVL16
MU_BODVR15	CPPAAPP	BWMVR16
MU_BODDL18	CAPPAAP	BWMDL17
MU_BODDR18	CPPPAAP	BWMDR17
MU_BODDL17	CAPAPAP	BWMDL18
MU_BODDR17	CPPAPAP	BWMDR18
MU_BODVR20	ABPRPPPPPAA	BWMVR19
MU_BODDL20	CAPPPAA	BWMDL19
MU_BODDR20	CPPPPAA	BWMDR19
MU_BODVL20	CAPAPPA	BWMVL20
MU_BODVR19	CPPAPPA	BWMVR20
MU_BODDL19	CAPPAPA	BWMDL20
MU_BODDR19	СРРРАРА	BWMDR20
MU_BODVL22	CAPAPPP	BWMVL22

MU_BODVR22	CPPAPPP	BWMVR22
MU_BODDL22	CAPPPAP	BWMDL22
MU_BODDR22	CPPPPAP	BWMDR22
MU_BODVL23	CAPPPPV	BWMVL23
MU_BODDL24	CAPPPPD	BWMDL23
MU_BODDR24	CPPPPPD	BWMDR23
MU_BODVR24	CPPPPPV	BWMVR24
MU_BODDL23	CAPPAPP	BWMDL24
MU_BODDR23	СРРРАРР	DEP
MU_ANAL	ABPLPPPPPAP	BWMDR24
MU_INT_L	ABPLPPPPPAA	IML
MII INT D	MCDDAADD	TMD

MU\_INT\_LABPLPPPPPAAIMLMU\_INT\_RMSPPAAPPIMRMU\_SPHABPRPPPPAPSPH

PM1DL ABARAAPAAAP
PM1DR ABARAAPAAP
PM1L ABARAAAAAP
PM1VL ABALPAAAAPA
PM1R ABARAAAAAPP
PM1VR ABARAAAAPA

PM2DL ABARAAPAAPA ABARAAPPAPA PM2D1 PM2DR ABARAAPPAPA ABARAAPAAPA PM2D2 PM2VL ABALPAAAAAP\_ABALPAAAPAA PM2VL1 ABALPAAAPAA\_ABALPAAAAAP PM2L PM2VL2 PM2VR ABARAPAAAAP\_ABARAPAAPAA PM2VR1 PM2R ABARAPAAPAA\_ABARAPAAAAP PM2VR2

PM3DL **MSAAAPAAA** PM3DR MSPAAAAPA PM3L **ABALPAAPAPP** PM3VL **ABALPAPPPP** PM3R **ABARAPAAPPA** PM3VR **ABARAPAPPPP** PM4DL **MSAAAAAPP** PM4DR **MSPAAAAPP** PM4L **MSAAAPAAP** PM4VL **MSAAPAAAA** PM4R **ABARAAAPAPP** 

PM4VR **MSPAPAAAA** PM5DL **MSAAAAPAP** PM5DR **MSPAAAPPA** PM5L **ABARAAPAPAP** PM5VL **MSAAPAAAP** PM5R **ABARAAPPPAP** PM5VR **MSPAPAAAP** PM6D **MSPAAAPPP** PM6VL MSAAPAPPA PM6VR **MSPAPAPPA** PM7D **MSAAAAPPP** PM7VL **MSAAPAAPP** PM7VR **MSPAPAAPP** PM8 MSAAAPAPP MC1DL ABALPAAPAPA MC1DR ABARAAAPAPA MC1V **ABALPAPPPPA** MC2DL **ABARAAPAAPP** MC2DR **ABARAAPPAPP** MC2V **ABARAPAPPPA** MC3DL **MSAAAPAPA** MC3DR **MSPAAPAPA** MC3V ABAL PAPPAPP VPI1 **MSPAAPAPP** VPI2DL **MSAAPAPPP** VPI2DR **MSPAPAPPP** VPI2V **MSAAPPAA** VPI3D **MSAAAPPP** VPI3V **MSAAPPAP** G1AL **MSAAPAAPAA** G1AR **MSPAPAAPAA** G1P **MSAAAAAPAP** G2L **MSAAPAPAA** G2R **MSPAPAPAA** I1L **ABALPAPPPAA** I1R **ABARAPAPPAA** 

I2L ABALPAPPAAPA I2R ABARAPAPAAPA 13 **MSAAAAAPAA** Ι4 MSAAAAPAA 15 **ABARAPAPAPP** 16 **MSPAAAPAA** MCL ABALPAAAPPP MCR **ABARAPAAPPP** MΙ **ABARAAPPAAA** NSML **ABARAAPAPAAV NSMR ABARAAPPPAAV** Μ1 **MSPAAPAAA** ABARAAPAPPA M2L M2R **ABARAAPPPPA** M3L **ABARAAPAPPP** M3R **ABARAAPPPPP** Μ4 **MSPAAAAA** M5 **MSPAAAPAP BDUR ABARPPPAPPP BDUL ABARPPAAPPP ALML ABARPPAAPPA ALMR ABARPPPAPPA** CANR ABALAPPAPPA **CANL ABALAPAAAPA HSNL ABPLAPPPAPPA HSNR ABPRAPPPAPPA** AVG **ABPRPAPPPAP** SABD **ABPLPPAPAAP SABVL ABPLPPAPAAAA SABVR ABPRPPAPAAAA** RIGL **ABPLPPAPPAA RIGR ABPRPPAPPAA** RIFL **ABPLPPAPAAAP RIFR ABPRPPAPAAAP** DD1 **ABPLPPAPPAP** DD2 **ABPRPPAPPAP** 

DD3 **ABPLPPAPPPA** DD4 **ABPRPPAPPPA** DD5 **ABPLPPAPPPP** DD6 **ABPRPPAPPP** DA1 **ABPRPPAPAAP** DA2 **ABPLPPAPAPA** DA3 **ABPRPPAPAPA** DA4 **ABPLPPAPAPP** DA5 **ABPRPPAPAPP** DA6 **ABPLPPPAAAP** DA7 **ABPRPPPAAAP** DA8 **ABPRPAPAPPP** DA9 **ABPLPPPAAAA** 

DB1 ABPLPAAAAPP\_ABPRPAAAAPP

DB2 ABARAPPAPPA

DB3 ABPRPAAAAPP ABPLPAAAAPP

**ABPLAPAPPPPAA** 

DB4 **ABPRPAPPAPP** DB5 **ABPLPAPAPPP** DB6 **ABPLPPAAPPP** DB7 **ABPRPPAAPPP PVT ABPLPAPPPPA PVPL ABPLPPPPAAA PVPR** ABPRPPPPAAA **PVQL ABPLAPPPAAA PVQR ABPRAPPPAAA** PHAL **ABPLPPPAAPP PHAR ABPRPPPAAPP PHBL ABPLAPPPAPPP PHBR ABPRAPPPAPPP** LUAL **ABPLPPPAAPAP** LUAR **ABPRPPPAAPAP PVCL** ABPLPPPAAPAA **PVCR ABPRPPPAAPAA** ALNL **ABPLAPAPPPPAP ALNR ABPRAPAPPPPAP** 

PLML

PLMR	ABPRAPAPPPPAA	
PVR	CAAPPV	
DVA	ABPRPPPPAPP	
DVC	CAAPAA	
ARC_ANT_V	ABALPAPAAPA	ARCAV
ARC_ANT_DL	ABALPAAPPAA	ARCAL
ARC_ANT_DR	ABARAAAPPPA	ARCAR
E1D	ABARAAAAPAP	
E1VL	ABARAAAAAA	
E1VR	ABARAAAAPA	
E2V	ABALPAPPAPA	E2D
E2DL	ABALPAAPAAP	E2VL
E2DR	ABARAAAPAAP	E2VR
E3D	ABARAAPAAAA	
E3VL	ABALPAAAAA	
E3VR	ABARAPAAAAA	
В	ABPRPPPPAPA	
F	ABPLPPPPAPP	
K	ABPLPAPPPAA	
K'	ABPLPAPPPAP	
U	ABPLPPPPAPA	
Y/PDA	ABPRPPPAAAA	
HYP3_ABPLAAPAAAA	ABPLAAPAAAA_ABPRAAPAAAA	HYP3 ABPLAAPAAAA
HYP3_ABPRAAPAAAA	ABPRAAPAAAA_ABPLAAPAAAA	HYP3 ABPRAAPAAAA
HYP4_ABARPAPAPA	ABARPAPAPA	HYP4 ABARPAPAPA
HYP4_ABPLAAPPAA	ABPLAAPPAA_ABPRAAPPAA	HYP4 ABPLAAPPAA
HYP4_ABPRAAPPAA	ABPRAAPPAA_ABPLAAPPAA	HYP4 ABPRAAPPAA
HYP5_ABARPAPPAP	ABARPAPPAP	HYP5 ABARPAPPAP
HYP5_ABPLAAAPAP	ABPLAAAPAP	HYP5 ABPLAAAPAP
HYP6_ABPLAAAAPA	ABPLAAAAPA	HYP6 ABPLAAAAPA
HYP6_ABARPAAPAA	ABARPAAPAA	HYP6 ABARPAAPAA
HYP6_ABPLAAAAPP	ABPLAAAAPP	HYP6 ABPLAAAAPP
HYP6_ABARPAPAPP	ABARPAPAPP	HYP6 ABARPAPAPP
HYP6_ABPLAAPPAP	ABPLAAPPAP_ABPRAAPPAP	HYP6 ABPLAAPPAP
HYP6_ABPRAAPPAP	ABPRAAPPAP_ABPLAAPPAP	HYP6 ABPRAAPPAP
HYP7_ABARPAAPAP	ABARPAAPAP	HYP7 ABARPAAPAP

HYP7_ABARPAAPPA	ABARPAAPPA	HYP7 ABARPAAPPA
HYP7_ABPLAAPPPA	ABPLAAPPPA_ABPRAAPPPA	HYP7 ABPLAAPPPA
HYP7 ABPRAAPPPA	ABPRAAPPPA ABPLAAPPPA	HYP7 ABPRAAPPPA
HYP7_ABARPPPAPA	ABARPPPAPA	HYP7 ABARPPPAPA
HYP7 ABARPPAAPA	ABARPPAAPA	HYP7 ABARPPAAPA
HYP7 ABARPAAPPP	ABARPAAPPP	HYP7 ABARPAAPPP
HYP7 ABPLAAPPPP	ABPLAAPPPP	HYP7 ABPLAAPPPP
HYP7_ABPRAAPPPP	ABPRAAPPPP	HYP7 ABPRAAPPPP
HYP7_CAAAAA	CAAAAA	HYP7 CAAAAA
HYP7_CPAAAA	CPAAAA	HYP7 CPAAAA
HYP7_CPAAAP	CPAAAP	HYP7 CPAAAP
HYP7_CAAAAP	CAAAAP	HYP7 CAAAAP
HYP7_CPAAPA	CPAAPA	HYP7 CPAAPA
HYP7_CAAAPA	CAAAPA	HYP7 CAAAPA
HYP7_CAAAPP	CAAAPP	HYP7 CAAAPP
HYP7_CPAAPP	CPAAPP	HYP7 CPAAPP
HYP7_CPAPAA	CPAPAA	HYP7 CPAPAA
HYP7_CPAPAP	CPAPAP	HYP7 CPAPAP
HYP7_CAAPPD	CAAPPD	HYP7 CAAPPD
HYP7_CPAPPD	CPAPPD	HYP7 CPAPPD
HYP7_ABPLAPPPPA	ABPLAPPPPA_ABPRAPPPPA	HYP7 ABPLAPPPPA
HYP7_ABPRAPPPPA	ABPRAPPPPA_ABPLAPPPPA	HYP7 ABPRAPPPPA
HYP8_ABPLPPPAPAP	ABPLPPPAPAP	HYP8 ABPLPPPAPAP
HYP9_ABPRPPPAPAP	ABPRPPPAPAP	HYP9 ABPRPPPAPAP
HYP10_ABPLPPPPPPP	ABPLPPPPPPP_ABPRPPPPPPP	HYP10 ABPLPPPPPPP
HYP10_ABPRPPPPPP	ABPRPPPPPPP_ABPLPPPPPPP	HYP10 ABPRPPPPPPP
HYP11_CPAPPV	CPAPPV	HYP11 CPAPPV
EXC	ABPLPAPPAAP	
VIRL	ABPRPAPPPPP	
VIRR	ABPRPAPPPPA	
AMSHL	ABPLAAPAAP	
AMSHR	ABPRAAPAAP	
PHSHL	ABPLPPPAPAA	
PHSHR	ABPRPPPAPAA	
ADESHL	ABARPPAAAA	EXC GL L
ADESHR	ABARPPPAAA	EXC GL R

HOL HOR H1L	ABPLAAAPPA ABARPAPPPA ABPLAAAPPP
H1R	ABARPAPPPP
H2L	ABARPPAAAP
H2R	ABARPPPAAP
G1	ABPRPAAAAPA
G2	ABPLAPAAPA
W	ABPRAPAAPA
P1/2L	ABPLAPAAPP
P1/2R	ABPRAPAAPP
P11/12L	ABPLAPAPPA
P11/12R	ABPRAPAPPA
P3/4L	ABPLAPPAAA
P3/4R	ABPRAPPAAA
P5/6L	ABPLAPPAAP
P5/6R	ABPRAPPAAP
P7/8L	ABPLAPPAPP
P7/8R	ABPRAPPAPP
P9/10L	ABPLAPAPAP
P9/10R	ABPRAPAPAP
QL	ABPLAPAPAAA
QR	ABPRAPAPAAA
V1L	ABARPPAPAA
V1R	ABARPPPPAA
V2L	ABARPPAPAP
V2R	ABARPPPPAP
V3L	ABPLAPPAPA
V3R	ABPRAPPAPA
V4L	ABARPPAPPA
V4R	ABARPPPPPA
V5L	ABPLAPAPAAP
V5R	ABPRAPAPAAP
V6L	ABARPPAPPP
V6R	ABARPPPPP
TL	ABPLAPPPPP

H0L H0R

TR	ABPRAPPPPP	
M	MSAPAAP	
Z1	MSPPPAAP	
Z4	MSAPPAAP	
CCAL	MSAPAPAAA	CCL1
CCAR	MSPPAPAAA	CCR1
CCPR	MSPPAPAAP	CCR2
CCPL	MSAPAPAAP	CCL2
RECT_D	ABPLPAPPPPP	REPD
RECT_VL	ABPLPPPPAAP	REPVL
RECT_VR	ABPRPPPPAAP	REPVR
Z2	P4P	
Z3	P4A	